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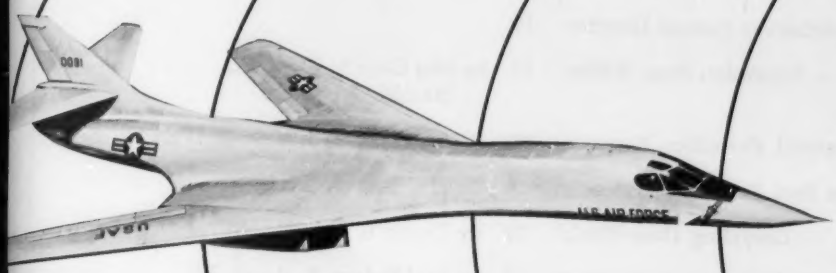

WHAT'S AHEAD?

FOR AIR FORCE CIVIL ENGINEERING

AIR FORCE Civil Engineer

USAF RECURRING PUBLICATION CE 85-1 VOL 15 NO 1 FEBRUARY 1974

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The AIR FORCE CIVIL ENGINEER is an official nondirective Headquarters US Air Force publication published quarterly under provisions of Chapter 2, AFM 5-1. Its purpose is to provide Air Force Civil Engineers with a timely and comprehensive picture of the importance, wide ranging involvement and direct relationship of civil engineering activities to successful accomplishment of the Air Force mission. It provides current information about significant civil engineering programs and accomplishments throughout the Air Force; pertinent developments in science engineering and management; and educational/training opportunities for enhancing professional thought and development. The Journal is edited and published by the Civil Engineering School, Air Force Institute of Technology. Contributions, suggestions and criticism are welcome. Opinions expressed do not necessarily reflect the official viewpoint of the Department of the Air Force, the Director of Civil Engineering or the editorial staff. DISTRIBUTION: F. The Journal's annual subscription prices are: $2.15 domestic; $2.70 foreign; 60 cents per copy. Mail check or money order to Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

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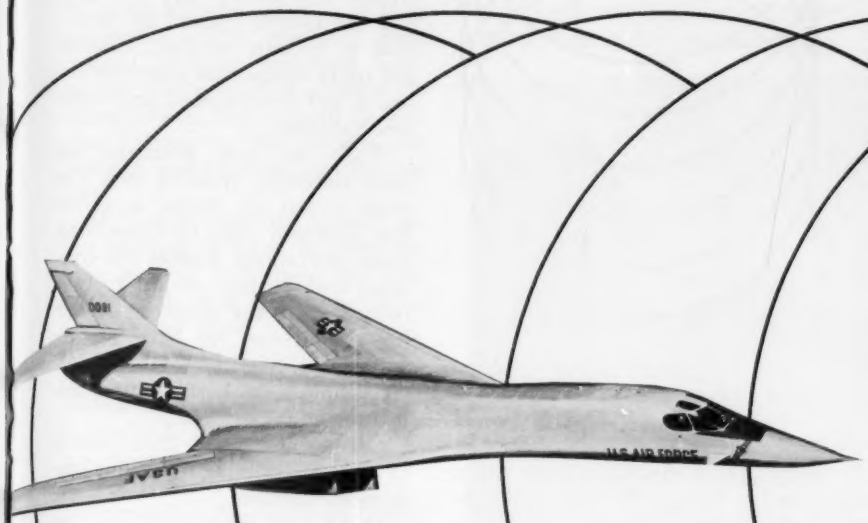

WHAT'S AHEAD?

in

Management & Resources

Contingency Readiness

New Construction

Energy Shortage

Personnel

Family Housing

Environmental Protection

Urban Encroachment

Editor's Note: The month of February 1974 signals the conclusion of especially significant milestones in the career of Maj Gen M. R. Reilly, and also heralds the beginning of new challenges for him for the future. General Reilly will be completing over 26 years of continuous active duty service in Air Force Civil Engineering this month and brings to a close his tenure as 10th Director of Air Force Civil Engineering since 1 January 1972. As of 1 March 1974, he will be the Commander of Headquarters Command, Bolling AFB, Washington, D.C. On the eve of his departure as the Chief Engineer in the Air Force, he has agreed to a question and answer report on his views about Air Force Civil Engineering and states what he believes are the directions it will be taking to meet the increased demands levied upon it to confidently face the challenges of the future.

CIVIL ENGINEER: General Reilly, how do you view the role of civil engineering in the Air Force today and tomorrow?

GENERAL REILLY: I feel very strongly that there is nothing more fundamental to the functioning of aerospace weapons systems and Air Force personnel than the facilities which constitute the physical make-up of our air bases and other installations.

Without ground facilities, aircraft and missiles don't fly. On the personnel side we should consider the intimate daily association one has at an air base with facilities and the related activities of civil engineers. The morale, well being and job effectiveness of Air Force people are closely tied to their facilities environment. It's no wonder that civil engineering support, whether it be good or bad, is so close to human concern and emotion.

In my view, the civil engineering job of providing effective facilities and utilities at minimum cost is more important today than ever before in carrying out the overall Air Force mission. I predict it will become even more important as we satisfy the future needs of weapons systems and Air Force personnel.

CIVIL ENGINEER: General Reilly, from your vantage point at Headquarters US Air Force, what is your assessment of Air Force Civil Engineering, world-wide?

GENERAL REILLY: As we move into 1974, I believe civil engineering is very healthy and civil engineers are doing a first rate job everywhere. Our bases never looked better and I can't put my finger on a single instance where civil engineering is failing in hard core operational support. Too much time is being spent worrying about our $7 billion deficiency in new construction and $200 million in so-called BEMAR (backlog essential maintenance and repair). These fat figures represent what we would like to do, but are out of all proportion with the realities of today and tomorrow. If the national debt was a measure of today's economy, America would be in bad shape. I tend to view a $200 million BEMAR in much the same light. On the basis of common-sense achieveable standards, we are holding our own. Our commands and bases deserve a lot of credit for what in my view is a superior facilities job against tough odds. We can't afford to waste an ounce of energy on things that just aren't going to happen in the foreseeable future.

CIVIL ENGINEER: You mentioned about the realities of today and tomorrow. Will you please elaborate?

GENERAL REILLY: What we are experiencing in civil engineering today is symptomatic of what is happening throughout the Air Force, and throughout the Department of Defense for that matter. Statistics bear out my point.

In FY 1968, it cost the Air Force $8.4 billion to pay 1,246,000 personnel. In FY 1973, it cost about $10.8 billion to pay 980,000 personel. The pay of personnel has reached the staggering proportion of about 45 percent of the Air Force's total annual budget. Aircraft procurement is the lowest in 30 years. Less than 130 new aircraft will be purchased in FY 1974. The Air Force inventory of planes is down one third since 1965; however, the cost to operate this lesser number of aircraft is up 64 percent over the cost in FY 1965. Air Force operating expenses now consume well over half the total Air Force budget and continue to increase. This means that less than half the budget dollars are available to procure aircraft, missiles and other equipment; carry out research and development; and build new facilities.

While our base structure has been materially reduced over the years, it has not begun to offset the increased cost of supporting those that remain. Studies will continue with a view toward further reductions in the structure of our bases; however, we have almost reached the limit in meaningful dollar savings from base closures unless forces are reduced.

Let me now relate these trends to civil engineering – a first line support function.

In FY 1969 the payroll for some 101,000 civil engineers was $605 million. In FY 1973 strength had dropped to 76,500 personnel; however, the payroll increased to $703 million. I anticipate total personnel costs to increase despite even further reductions in strength. At the typical air base in FY 1974, we estimate that military and civilian salaries will represent 57 percent of civil engineering expenses; at least 15 percent will go to pay for utilities; and another 8 percent will pay for minimum essential contract services. This leaves 20 percent to buy supplies for the in-house work force and to pay for projects accomplished by contract. Looking at it another way, we expect only about 38 percent of the total expense to be applied directly to faci-

lities maintenance and repair. The remainder will be eaten up in engineering and administration, utilities operation and fuels, fire protection, and services. The ground rules are already mighty tough. I predict they will get tougher as we feel the full impacts of such things as continuing inflation, environmental quality goals, more stringent health and safety standards, increased working and living standards, the all volunteer force, urban encroachment, land use controls, facility siting criteria and the ramifications of the energy shortage.

Our Air Force leaders are faced with the gigantic task of allocating resources within relatively fixed annual budgets, shrinking manpower and unyielding mission responsibilities. And many of the factors bearing on the problem are without precedent in military annals.

My point is that the climate we are working in today is pretty severe and all indications are that the climate will get even leaner in the years ahead.

CIVIL ENGINEER: And how do you think we must react to the conditions you have just described?

GENERAL REILLY: In a Pentagon news conference last fall, Sectary of Defense James R. Schlesinger presented the challenge facing us very clearly when he stated that we are striving to maintain our force structure and are looking for all opportunities for squeezing down on the support side. In this squeezing down process, civil engineers are faced with no alternative but to find better ways to do our job. As a first line function, civil engineering has its work cut out for itself because it accounts for one third of the total base operating support budget at the average base.

Past experience and traditional approaches aren't going to see us through. We must push technology to the limit, and develop better processes, engineering techniques and management procedures. We must also take further steps to ensure sound, efficient management and the best possible utilization of people.

The challenges confronting the Air Force are too demanding, and our mission too critical to entrust our future to any lesser approach. Further dedication is required to handle today's job routinely so that full attention may be given to the challenges of tomorrow.

CIVIL ENGINEER: General Reilly, we would now like you to comment on some specific aspects of civil engineering with a view to the future. Would you please address resources management first?

GENERAL REILLY: No matter how much one hears about management these days, its importance can't be overstated. In talking to young civil engineers, I like to point out that those who cannot combine technical expertise with the application of sound management have no future in our business. As payroll and materiel costs continue to rise, management must receive ever increasing attention.

The main resources management job centers around manipulation of those elements of civil engineering expense I mentioned earlier. I like to think of these elements of expense (payroll, utilities, services by contract, supplies and projects by contract) as segments of a circle whose area is fixed by budget limitations. An expansion of any one segment must be offset by a corresponding reduction somewhere. There is just no way to increase the degrees in that circle beyond 360. As the payroll and utilities cost segments continue to expand, it means less money is available for projects by contracts and to buy supplies. And, of course, supplies are the key to productivity of the in-house work force. It's no wonder that productivity is receiving so much management attention.

Concerted efforts are underway to achieve better planning and scheduling for positive, single point direction and control of the work force; a better system for identifying work; and for improved supply and transportation responsiveness.

New officers quarters at Wright-Patterson AFB, Ohio.

I think the management system set forth in our relatively new manual 85-1 is sound and will suffice for the time being, provided that there is dedicated application to procedural compliance, that we adopt a professional "can do, will do" attitude, and that there is straightforward **leadership** and **direct involvement** by those in positions of responsibility.

Our basic management system must also be enhanced through advanced technology and improved processes and engineering techniques as I mentioned earlier. For example, the time has come when

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What's Ahead?

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we must get on with the installation of central utilities surveillance and control systems. But, in summary, the real key to meeting the management challenge is our number one resource—people, and our number one manager—the base engineer.

CIVIL ENGINEER: General Reilly, you just spoke of people as our number one resource in meeting the management challenge. Would you please comment further on this?

GENERAL REILLY: Yes, the prime element that makes civil engineering go is people. Certainly, we must have dollars for supplies, contracts, equipment, and to pay the utilities bills, but accomplishment of our job is primarily dependent upon getting good people, providing adequate education and training, giving them the resources to do the job, and then insuring that they do it. It is a primary responsibility of all of our civil engineering supervisors to motivate people and lead them. We must single out the most capable and insure that they are given challenging assignments to fit them for positions of increasing responsibility as they gain experience.

The civil engineering training school at Sheppard AFB, Texas, and the Civil Engineering School under the Air Force Institute of Technology at Wright - Patterson AFB, Ohio, have for many years played a key role in civil engineering training and education. In the years ahead their programs will play an even more important role as personnel strength is further reduced. Also, the programs must be constantly reviewed and adjusted to keep pace with changes in civil engineering.

CIVIL ENGINEER: General Reilly, what do you think we can expect in annual military construction?

GENERAL REILLY: The annual military construction program appropriated by Congress has averaged about $280 million over the last five years, exclusive of family housing construction. While prospects for FY 1975 look considerably brighter at the moment, I honestly don't expect our annual programs for the normal run of base projects to go very much above the $300 million level in the foreseeable future.

Funding of special, high cost projects such as the New Generation Hospital, national test facilities at Arnold Engineering Development Center, space transportation system support, etc., could, of course, materially increase the size of any given fiscal year program. While we naturally feel strongly about new construction, I think those big annual programs are luxuries that we will have to do without. There are new construction necessities which, in the light of our budgetary restraints, we shall have to acquire more slowly than some would like.

"My point is that the climate we are working in today is pretty severe and all indications are that the climate will get even leaner in the years ahead."

We must also keep in mind that there are many factors which indicate that we will obtain fewer facilities for our annual investment. For example, construction costs continue to rise, new and more stringent requirements must be included in our facilities and systems to meet environmental requirements, and the energy shortage dictates the need for conservation to be designed into each facility. Also, there are increased costs due to improved seismic considerations and health and safety considerations.

Another significant factor for consideration is the ever increasing standard of living for the American people. This, coupled with the expiration of the Selective Service Act, causes the Air Force to devote increased attention to the amenities required to attract and retain our highly skilled military force with an increased cost, of course, for our people-oriented facilities. The net result is that we must invest our construction dollars more wisely. The real challenge is to find new ways, techniques, technology, design solutions, construction innovations and management improvements to obtain the maximum construction for every dollar invested.

The pressures to provide facilities for new weapons systems have subsided and each year we are putting a greater proportion of the construction programs into replacement and upgrading, or modernization type projects. In FY 1970, 20 percent went for modernization. In the FY 1974 program, modernization projects represent almost 65 percent of the total. At the moment, I don't see any new weapon systems on the horizon which would seriously compete with modernization projects for the construction dollar. The F-15, for example, will require only modest outlays for new facilities. The same will hold true for the B-1 bomber.

Currently, we are in the third year of a five-year $250 million program to modernize facilities at the five primary depots within Air Force Logistics Command. This is by far the most cost effective facilities modernization program ever undertaken.

We are also greatly accelerating the replacement and modernization of our medical facilities in a program spurred by OSD. Many projects are already underway with many more on the drawing boards and in future programs. In addition, the Air Force is deeply involved in the New Generation of

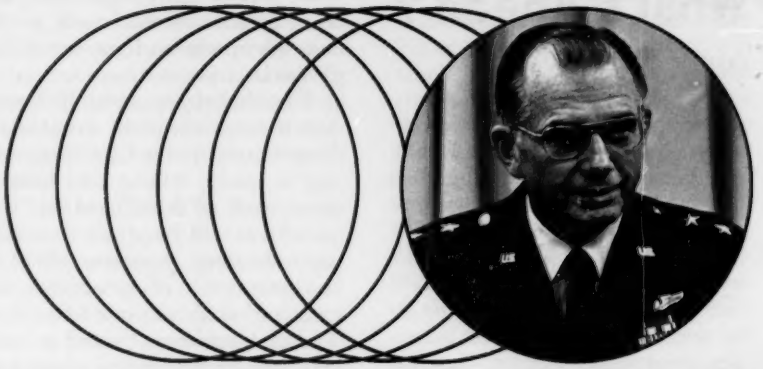
Military Hospitals program which I mentioned a moment ago. This program was initiated by the Secretary of Defense in 1968 and was assigned to the Air Force as executive agent in December 1971. The program includes an evaluation of national health care delivery and the consideration of new concepts and advances which may be applied to a new health care project.

These new options are originating from industry and professionals in medicine, administration, architecture, engineering, data automation, communications and other special fields. The end-product of this project should be a new military health care delivery facility and system designed as a prototype or test-bed. The site for construction of this new generation facility will be Travis AFB, California. Considerable effort in its development has already been accomplished and the actual facility design is just getting underway. We can expect many spin-offs from this program which can be applied to other types of facilities, especially in the areas of data automation and communications.

CIVIL ENGINEER: General Reilly, in your discussion on military construction, you excluded family housing. Would you care to comment on that aspect of the annual programs?

GENERAL REILLY: Civil Engineering support to the Air Force would be less than complete if we neglected our responsibility to provide adequate homes for our people. This challenge provides the purpose for our annual family housing program. It allows us to address the spectrum of human needs, events and circumstances in each Air Force community for the purpose of improving the day-to-day "Quality of Residential Life" of our people.

Our effort is directed toward creating livable communities, whether it is through the encouragement and cooperation of local populous support, new Air Force home construction, improvements to existing on-base quarters, extensive maintenance efforts, or even leased facilities when needed. We have channeled an average of $360 million annually into this effort.



"The real key to meeting the management challenge is our number one resource — people, and our number one manager—the base engineer."

Some significant changes are taking place. Substantial increases in military pay and rental allowances, coupled with changes in OSD criteria, have resulted in a major decrease in the deficiency of on-base housing. The cost of community housing may rise to meet the increased dollar availability, putting us right back where we started, but at this point, this is pure speculation. At any rate, construction of new units has decreased over the last three years. In FY 1972, 3,600 new units were approved, 3,168 in FY 1973, and 1,700 units in FY 1974. My guess is that we will be building in the neighborhood of about 2,000 a year for a while unless there is a change in rules for computing deficiencies.

A change in policy to make lower grade airmen eligible for government housing could, of course, result in expanded annual construction programs. The Air Force would like to see all military personnel eligible for housing; however, we must recognize the budget implications associated with such a change in policy. I predict a gradual approach to the matter, and some annual new construction to support the lower grade personnel.

To counterbalance to a degree the reduction in new unit construction, we have been able to obtain an increased level of funding for improvements to existing quarters. The FY 1974 program provides $24 million for improvements to some 4,500 units. This is quite a difference from $12 million in FY 1973 and $4.5 million in FY 1972. If we could get $40 million a year for the next five years, we could just about bring our inventory up to standards. We tried to reach that level for FY 1975 but will have to settle for a level of funding about the same as in FY 1974. We will give it another try for FY 1976.

I might also add that improvements programs this year will consist of large "total" projects in lieu of small dollar value increments. The increased funding level will permit large projects to eliminate all deficiencies at one time, rather than the incremental approach at a higher total cost over a period of several years. These improvements programs will be geared toward making older housing more liveable and more compatible with recent new construction.

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What's Ahead ?

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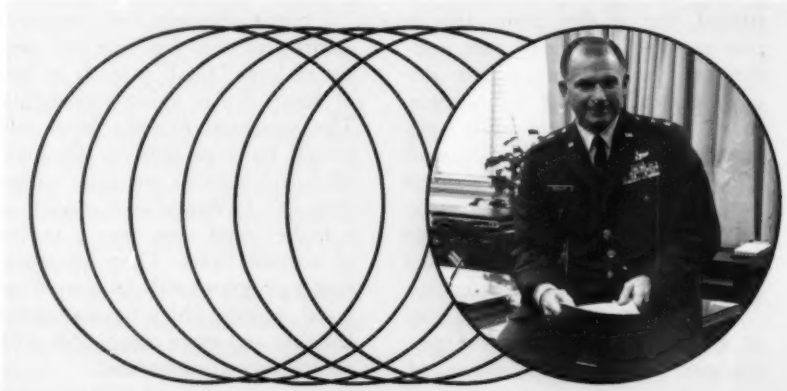
The increased cost of new construction has forced us into finding better approaches to building houses. Business as usual will not suffice anymore. The one-step or "turnkey" method which we started using extensively in the FY 1972 and 1973 programs is proving to be very successful. In most instances, we will use architect-engineer firms for design of improvements projects and the normal procurement system.

Despite our lack of success with the FY 1972 program, we are not abandoning industrialized construction. The industrialized process and methodology will continue to be welcome and acceptable for all Air Force family housing projects; however, they must compete on the open market. When industry is ready, we're ready for the full factory-house or single component. We must continue to look for better ways, techniques and materials for our family housing construction. Our new construction must continue to incorporate methods and materials which will further reduce operation and maintenance costs and, at the same time, increase energy conservation. The use of solar energy for the space heating of our homes holds promise. In this regard, the Air Force Academy is currently considering the modification of two housing units to do solar energy research. As in many other areas of civil engineering, we must continue to find ways to obtain the maximum for every dollar invested.

The challenges ahead in family housing are certainly formidable; however, Air Force Civil Engineering is ready, willing and able to meet each of them head on. Our objectives will be attained, not by new funding programs, but by a combination of specialized talents and skills, an involvement of knowledgeable, motivated individuals, and an application of our best mental resources.

CIVIL ENGINEER: It was just four years ago that President Nixon set in motion a massive program to clean up the Nation's environment. By Executive Order, the Department of Defense was charged with major responsibilities. General Reilly, how has the Air Force responded to the environmental protection movement and what are your thoughts about the future?

GENERAL REILLY: In my view, the Air Force acted very wisely back in 1970 by immediately centralizing Headquarters US Air Force environmental protection matters within the Directorate of Civil Engineering under the Deputy Chief of Staff, Programs and Resources. We followed by quickly setting up our Environmental Protection Group. With the air cleared on responsibilities and a focal point for action, we got things rolling in a hurry. While I will not go into the details, fine progress has been made in this rather brief span of years.



The Air Force is required by law to assess the environmental aspects of all proposed actions and legislative programs. Formal environmental statements are prepared when such assessments indicate that there are significant environmental consequences. Our first formal environmental statement covering a change in flying mission at Luke AFB, Arizona, was filed with the President's Council on Environmental Quality in August 1970. This was the first statement to be filed by a military service. Since that time, eleven additional statements and seven draft statements have been filed with the Council.

Our responsibility is not just to comply with the letter of the law, but we must fully integrate this assessment procedure, both in spirit and intent, into the total Air Force planning and decision making process. Assessments made early in the planning process will cause little, if any, delay in planned actions while deferred assessments and after-the-fact environmental statements can result in serious delays. Many state and local governments are already incorporating environmental assessments and other overall coordinating procedures in their planning processes. Our bases must become an integrated part of this planning process if we are to survive in this ever increasing public opinion environment.

Environmental protection is still viewed by many as just another obstacle in the way of getting the job done. This is understandable, but realistically speaking, environmental considerations are here to stay and we must fully integrate them into our business. Laws have been passed and some stiff quality goals have been established, with more to come. The water quality targets alone which have been set for the late 1970s and early 1980s will require a lot of doing on our part and lots of money.

The very real energy crisis which has seemed to crop up overnight very definitely relates to environmental quality. In some instances, energy considerations will raise en-

vironmental problems; in other instances, they can enhance environmental protection. For example, the shortage of oil and gas can drive us into using high sulphur coal in our heating plants with the resultant air pollution problem. On the other hand, reduction in the burning of fossil fuels and development of more efficient burning processes to conserve fuel will naturally ease the air pollution problem. It's too early to determine the full significance of the energy shortage in terms of environmental quality programs and targets.

The Air Force holds a position of leadership in the nation's environmental quality movement. Looking to the future, and in keeping with that leadership role, I think the Air Force must do several things. First, we must sustain the momentum of the programs now underway and continue to search for new and better ways to achieve environmental quality in all of the areas embraced, such as air, water, noise, solid waste, hazardous materials and natural resources. Secondly, the Air Force must develop its own program to maximize control of the emission of air pollutants and noise in current aircraft power plants and in future development programs. As you may know, only civilian aircraft can be regulated under provisions of the Clean Air Act. As the nations biggest user of jet engines, such action by the Air Force is consistent with the spirit and intent of the Clean Air and Noise Control Acts. Thirdly, I feel that added emphasis must be given to research and development across the full spectrum of environmental protection. I recognize, of course, the stiff competition for dollars within the annual R&D budget.

Finally, as individuals, we must consciously share the burden of leadership. Our direction is clearly spelled out by the Air Force's pledge to environmental protection which was just recently endorsed by the Secretary and the Chief of Staff of the Air Force. **(Editor's Note: The pledge appears on the back cover of this issue.)**

CIVIL ENGINEER: Closely related to the environmental issue, in its broad sense, is the problem of urban encroachment around our air bases. Would you please comment on what is being done to counter this problem and how you view the future?

GENERAL REILLY: The Air Installation Compatible Use Zone (AICUZ) concept which the Air Force pioneered is in high gear and will make a major contribution to the national environmental improvement effort. This concept provides a reasonable method for safeguarding the public from aircraft noise and accident hazard areas within air base environments. It is a specific means of analyzing and mapping noise and accident data to establish zones of compatability for aircraft operations and land use. Air Force policy is to achieve this compatability by means of a land use planning and zoning process carried out through appropriate, enabling legislation at the state level and ordinance enactment at the local level. The system used for determining compatibility embodies a method of projecting, mapping and defining aircraft noise and accident hazard areas in the air base environs.

"Our objectives will be attained, not by new funding programs, but by a combination of specialized talents and skills, an involvement of knowledgeable, motivated individuals and an application of our best mental resources."

As you are probably aware, we have been building up our planning expertise and capability in the Directorate of Civil Engineering. I have some very progressive thinkers who feel that AICUZ is just the initial step toward a new and much higher order of planning which will reach into all phases of Air Force community life. Please permit me to quote from a paper prepared by Mr Lester H. Henriksen and Lieutenant Gary D. Vest of my staff.

"The planning process will include the recognition of all community forces from detailed analysis of institutional and individual goals, to complete evaluation of natural environmental factors to the provision of social services. Facilities, programs and land usage will be responsive to demographic factors, health needs, transportation requirements and law enforcement. It will bring together all aspects of community life in a coherent improvement effort. When this state of process is achieved, the Air Force will be in step with prevailing and emerging national concepts of maximum intergovernmental coordination, extra-territorial planning consciousness, greater people involvement and concern, and rejection of traditional philosophies. And the Air Force Base (community) will assume its place in the regional 'Ecosystem'."

It's this kind of thinking and planning that the Air Force must have. I am most encouraged by the fine start that has been made and the enthusiastic support we are receiving from the major air commands.

CIVIL ENGINEER: We all know that the operational forces and support structure must be kept in a state of constant readiness to react to future contingencies. How do you view this requirement from the standpoint of civil engineering?

GENERAL REILLY: In the area of civil engineering contingency readiness, we must sustain what the war in Southeast Asia set in motion. We cannot afford to have another lull in progress such as that which occurred between the end of World War II and the mid 1960s. Fortunately, the Prime BEEF concept was just emerging

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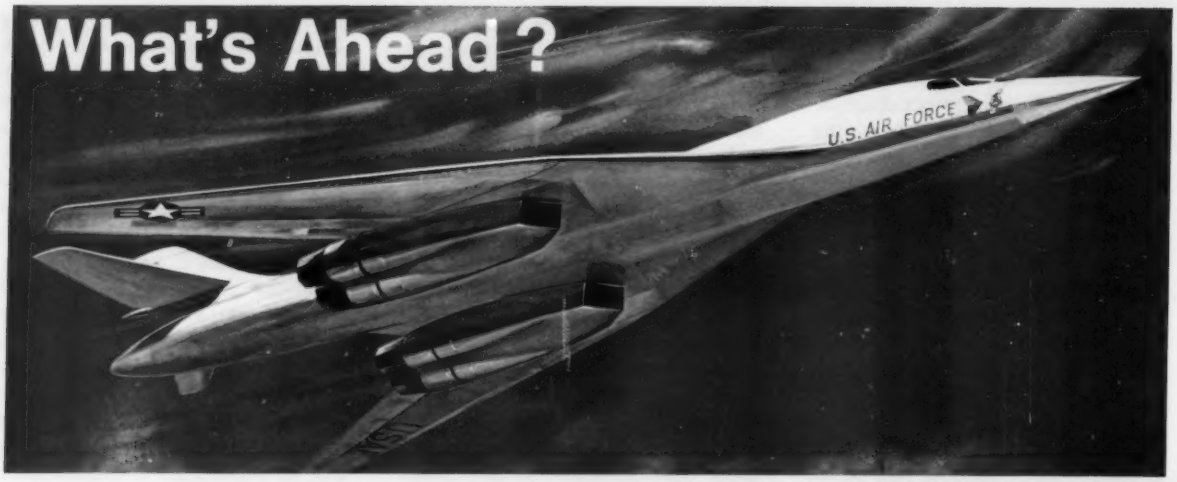


when things really ignited in Southeast Asia; however, in terms of equipment and engineering techniques, we found little progress had been made since 1945. We are all familiar with the all out catch up effort that ensued. Prime BEEF was proven, RED HORSE was born, and the ingenuity and abilities of civil engineers were again demonstrated.

Since most of our key military personnel have had experience in a combat operational support role, we must now project many of the engineering lessons learned and the technological advancements developed into our planning for future contingency readiness. The Air Force Bare Base program is a reality now and we must endeavor to refine it.

We must retain in the active and reserve forces the trained and ready RED HORSE capability to move out with the operational forces, to put them in business and bridge the gap until other designated construction forces can be brought into position, and to provide follow-on bomb damage repair and heavy repair as required. Similarly, a strong Prime BEEF posture must be maintained. The budget squeeze will make the retention of this readiness insurance tougher with each passing year.

I am also concerned that we do not relax in proceeding with a good level of research and development to enhance our contingency readiness and application. There are many contingency support problems already identified which need to be solved, together with those which will develop with changes in operational capabilities.

CIVIL ENGINEER: General Reilly, in your earlier discussion of environmental protection, you referred to the energy crisis. How do you view this major problem from the standpoint of Air Force Civil Engineering?

GENERAL REILLY: I'll say one thing—it has sure kicked off a flurry of activity at Headquarters US Air Force and in the field commands. When the crisis suddenly developed last fall, our immediate job was to get going on a program to achieve mandatory use reductions in FY 1974. Actions to conserve energy and reduce fuel consumption are now spreading to every aspect of Air Force operations. While aircraft account for roughly 90 percent of petroleum energy consumption in the Air Force, the civil engineer is still deeply involved with his utility plants and systems and wide range of facility support responsibilities. And when you start cutting back in heating, cooling, electricity and the like, you develop a great deal of interest in what you are doing. As I said earlier, its no wonder that civil engineering is so close to human concern and emotion.

I should point out that our efforts in conservation are not new. We have had a very active utilities conservation program in effect for a number of years, and with considerable success. However, up until now the motivating factor has been reduction in O&M costs. Now we have a second and very real incentive to reduce consumption.

While there are varied opinions on how severe the energy shortage will actually be, I am confident that the Air Force will successfully cope with the situation. It's going to require the active support of every individual and a sacrifice of some of the comforts and conveniences we have grown so accustomed to.

From an engineering standpoint I think the energy problem will do a lot of good. It's going to quickly purge our system of a lot of obsolete engineering, and greatly accelerate the introduction of those new techniques and design approaches that have been available for a long time but which we haven't applied for lack of interest or funds, or both. In addition, the gates are being opened to all kinds of new approaches. We civil engineers have never had a better opportunity to show our mettle.

CIVIL ENGINEER: From time to time, the view is expressed that civil engineering support could be provided more effectively if it were organized as a separate corps or service within the Air Force. How do you feel about this, General Reilly?

GENERAL REILLY: I am totally opposed to any such suggestion. We don't operate like the Army or Navy who fight in the field or at sea. The Air Force operates from air bases and I hope I have already made the point that facilities and civil engineering are fundamental to and inseparable from the operation. Here at the Headquarters, I work for the Deputy Chief of Staff, Programs and Resources. In the field, civil engineers report to their commanders. We are line of the Air Force and this is the way it should be. I consider myself an Air Force officer first, an engineer second.

CIVIL ENGINEER: General Reilly, you have served continually in Air Force Civil Engineering for more than 26 years at base level, at intermediate and major command headquarters, and for many years, at Headquarters US Air Force. What are the major changes in civil engineering that you have seen take place over that span of years?

GENERAL REILLY: For one thing, the magnitude of the civil engineering operation has changed tremendously. I entered the civil engineering business in late 1947 just at the time the Air Force was emerging as a separate military service. That year the fledgling Air Force found itself with but a fraction of its World War II operational strength and air base structure. It was operating on an annual budget of only two billion dollars, less than one-twelfth of that today. Civil engineering was in the hands of a nucleus of officers and civilians drawn from the Army Corps of Engineers. Our total real property worth was less than $6 billion, compared to some $17 billion today, on a first cost basis. There just weren't any O&M funds and the new construction program was zero. Today, real property O&M alone is a billion dollars a year. I continue to be surprised when I talk to people who think the big Army Air Corps of World War II simply carried on. The Air Force had a long hard climb back, and I'm proud to have been a part of civil engineering during that period.

A second thing that impresses me is how much more sophisticated civil engineering has become. It's a real science today. Back then we employed a lot of "seat of the pants" management as opposed to the much more detailed and standardized system employed today. I'm convinced we are operating much more efficiently now, though we must be careful not to over control. The base engineer must be given flexibility to exercise judgment and apply his own effective techniques.

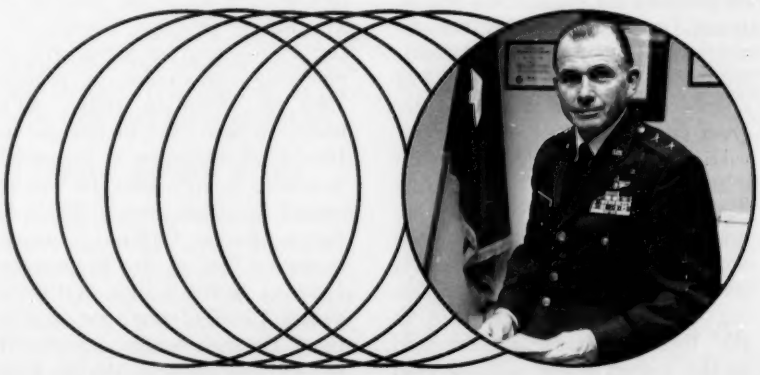
Thirdly, the worldwide civil engineering operation is much more closely knit today, another reason why I think we are operating much more efficiently. While civil engineering is a command function, we have a strong bond which begins with the Directorate of Civil Engineering. Modern communications and jet air travel have done wonders in getting on with the worldwide civil engineering job.

CIVIL ENGINEER: We've addressed some of the major issues that will confront Air Force Civil Engineers in the future. Now, as a final question, I would like to ask about your future as Commander of Headquarters Command. What are your feelings and concerns as you look forward to this new challenge?

GENERAL REILLY: I am extremely pleased about the new assignment, and appreciate very much the confidence placed in me by my superiors. As you know, Headquarters Command has very diversified operational and support responsibilities here in the Washington metropolitan area and at a multitude of locations all over the world. It's a fine opportunity to broaden my knowledge and experience, and I look forward to giving this new challenge, my very best efforts. And with major facilities development programs underway at Bolling and Andrews Air Force Bases, with tight operations and maintenance budgets, and with personnel support responsibilities throughout the US and overseas, I'll still be closely associated with civil engineering.

You will recall at the outset, I voiced the opinion that today Air Force Civil Engineering is healthy and civil engineers are doing a first rate job everywhere. One of the main reasons for this good state of affairs is that Commanders everywhere are involving themselves in civil engineering matters to an unprecedented degree. I see no slackening in this trend as we continue to squeeze down in the support area and the Commanders resources management job gets all the tougher. CE

'. . . today Air Force Civil Engineering is healthy and civil engineers are doing a first rate job everywhere.'



Major General B. J. McGarvey Named Director

11th Director of Civil Engineering to Take Command March 1st

Maj Gen Billie J. McGarvey becomes the 11th Director of Air Force Civil Engineering on 1 March 1974. He succeeds Maj Gen M. R. Reilly who will become the Commander of Headquarters Command, Bolling AFB, Washington, DC, effective the same date.

In assuming the top Civil Engineer's job in the Air Force, General McGarvey will be facing what are perhaps the most crucial challenges ever confronting Air Force Civil Engineering. The energy crisis and its impact on the Air Force, the ecology and environmental considerations, and budgetary limitations in an era of high inflation are only a few of the problems he will be charged with finding the solutions to in the years ahead. In addition, he will be looked upon to provide the managerial leadership and technical guidance for a work force of over 70,000 people to sustain a physical plant inventory having a current replacement value of well over $40 billion.

It is a challenge that may appear awesome but one that General McGarvey savours. His career has been a blend of quiet but dynamic leadership that has ensured success in all that he has undertaken.

General McGarvey was born in Fort Worth, Texas, 11 August 1923. He received his engineering education at Texas Technological University and the University of Colorado where he earned bachelor of science and master of science degrees in civil engineering.

His military career began with a call to active duty in the Army Air Corps in February 1943. He graduated from flying training the next year and was commissioned a second lieutenant. After completing a year of combat pilot duty in the Western Pacific he returned to the United States in May 1945

for a brief assignment as a flying instructor in the Western Flying Training Command. In March 1946, he was assigned to the Flight Test Division, San Antonio Air Materiel Area, Kelly Field, Texas, where he served as an engineering test pilot until June 1949.

After earning his master's degree through the Air Force Institute of Technology program, General McGarvey received his initial civil engineering assignment in January 1952 at Mountain Home AFB, Idaho. In June 1952, he became the Base Civil Engineer at Prestwick, Scotland. In July 1953, he was assigned to Headquarters Third Air Force, London, England, where he became Chief of the Engineering Division in the Office of the Assistant Chief of Staff for Installations. He then returned to the US in 1956 and attended the Air Command and Staff School at Maxwell AFB, Alabama.

In June 1957, General McGarvey was assigned to the Office of the Air Force Regional Civil Engineer, Southwest Region, Dallas, Texas, and in August 1960, he became the Civil Engineer for the Site Activation Task Force for constructing strategic missile facilities at Dyess AFB, Texas. His next assignment came in January 1962 at Headquarters Fifth Air Force in Japan, where he served as Chief of the Construction Division and as Assistant Deputy Chief of Staff, Civil Engineering.

He then moved to the Directorate of Civil Engineering, Headquarters US Air Force in June 1965 as Chief of the Missile Construction Branch. He later served as the Air Staff project officer for the Turn Key construction of Tuy Hoa AB, Republic of Vietnam. He then served as Chief of the Construction Division from April 1967 to August 1968.

General McGarvey was assigned to Headquarters Air Force Logistics Command in August 1968 as the Deputy Chief of Staff for Civil Engineering. The development and implementation of the Depot Plant Modernization Program and the design and construction of the new Air Force Museum at Wright-Patterson AFB, Ohio, highlighted this tour.

In June 1971, General McGarvey became the Deputy Chief of Staff for Civil Engineering at Headquarters Pacific Air Forces. He returned to Headquarters US Air Force in June 1972 to become the Deputy Director of Civil Engineering, Deputy Chief of Staff, Programs and Resources, and will become the Director on 1 March 1974. He is a registered Professional Engineer in the state of Texas. CE

A few years ago, Hickam AFB Civil Engineers critically reviewed the functional layout and natural boundaries of the base. They realized that serious problems existed. What follows is what was done to ease the problems and how a master plan was created to modernize the entire base.

The Hickam Plan--Expansion from Within

by Maj Gary S. Flora, PE, and Harold Chun, AIT

Hickam AFB, Hawaii had its origin in 1935 with the acquisition of 2,225 acres on the south shore of the island of Oahu, and through the years this acreage has remained relatively stable. Extensive growth and buildup of the surrounding area have resulted in a total encirclement of the base. To the east is bustling Honolulu International Airport, with its ever-expanding volume and diversity of air traffic. To the south is the US Army reservation, Ft. Kamehameha, while to the north and west is Pearl Harbor Naval Base and the channel to the Pacific Ocean. The "natural" boundaries are, therefore, fixed and prevent the usual expansion which is sometimes available through annexation.

A Mixture of Facilities

Over the 38 year existence of the base, a random mixture of permanent and temporary facilities have been constructed around a World War II type, triangular-shaped airfield complex. Many of the permanent structures have outlived their originally-designed use, and most of the temporary structures have far exceeded their economic life. The triangular-configured runway complex was converted to aircraft parking aprons when a joint-use civilian/military runway was constructed in the early 1950s. A cursory study of the base layout revealed that:

- Many functions were not consolidated properly;
- Undeveloped open areas existed; and
- Hazardous cargo and aircraft parking areas restricted future base development.

While geometry and natural features affected the base layout, other problems existed which had an impact on base development. For example, aircraft which operated in the heart of the base contributed to noise pollution and their operation was expensive because of the long taxi distance from the primary runway to the apron. Also, the parking apron, which is composed of asphaltic concrete, showed considerable signs of distress from the effects of C-141 and C-5 aircraft. To repair the pavement would be very expensive, aside from the fact that it is located in the wrong place. Another problem existed with the size and location of the hangars when considered in comparison to current requirements. All hangars except one were too small for the majority of the assigned or transiting aircraft. This resulted in poor utilization and space allocation.

Concept Initiated in 1970

Recognizing the problems which existed, and considering the permanence and importance of Hickam AFB, Headquarters US Air Force initiated a land-use concept in 1970. It reoriented the internal features of the base and would provide the basis for further study and analyses. The original proposal was modified to make maximum use of existing assets without violating good planning concepts. Subsequently, the creation and development of the many aspects of the master plan were completed, enabling the modernization program to proceed at a rapid pace.

A-E Firm Assists Base Team

An architect - engineering firm was engaged to assist a base team in completing studies and in the development of illustrative layouts. Among the many studies was an analysis of the base road network, which, through computer modeling, provided an insight into new street requirements. Also, a

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MAJOR FLORA *is Chief of Programs, 15th Civil Engineering Squadron, Hickam AFB, Hawaii. A graduate of the US Naval Academy, he received his master's degree in civil engineering from the University of Pittsburgh and a master's degree in business administration from Auburn University. He is a registered Professional Engineer in Colorado and Florida.*

HAROLD CHUN *has been a member of the Base Civil Engineer's staff at Hickam AFB, Hawaii, since 1966. A graduate of California Polytechnic State University with a degree in architectural engineering, he is currently Chief of the Advance Planning Section in the Programs Division. He is an Architect-In-Training in Hawaii.*

Hickam

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detailed study was made to determine the proper utilization of facilities, resulting in significant reallocation of real property assets.

An evaluation of land areas revealed that approximately 447 acres could be utilized in the modernization plan through the conversion of undeveloped areas and the acquisition of federal properties within the natural boundaries of the installation. At current market prices, the estimated value of this land is $45 million. Although some of the federal property has not been transferred to Air Force control, maximum use of the undeveloped areas within the base boundaries has become one of the major objectives of the modernization program. This will be achieved primarily by converting the open space in the center of the base and much of the old parking apron into other uses.

Located north of the proposed apron will be a family housing complex, including two new schools. Separating this area from the operational apron will be a buffer zone and operational support facilities. The apron and associated facilities will be relocated to the south and nearer to the primary runway. The magnitude of this effort, a funding point of view, necessitated creation of a complex phasing plan. Therefore, the implementation of this portion of the modernization program will require several years to complete, but through orderly phasing, will have minimum adverse effect on ground operations.

Improving Traffic Conditions

Another objective is to improve traffic conditions on base. This goal will be attained by routing the main base traffic along the east side and the south side of the new housing area. Existing aircraft parking aprons will provide the pavement for the majority of this route. Another improvement will be achieved by constructing a truck route to the warehouse and industrial sections of the base. This will divert heavy traffic from the housing and administrative areas of the base.

Results Are Displayed

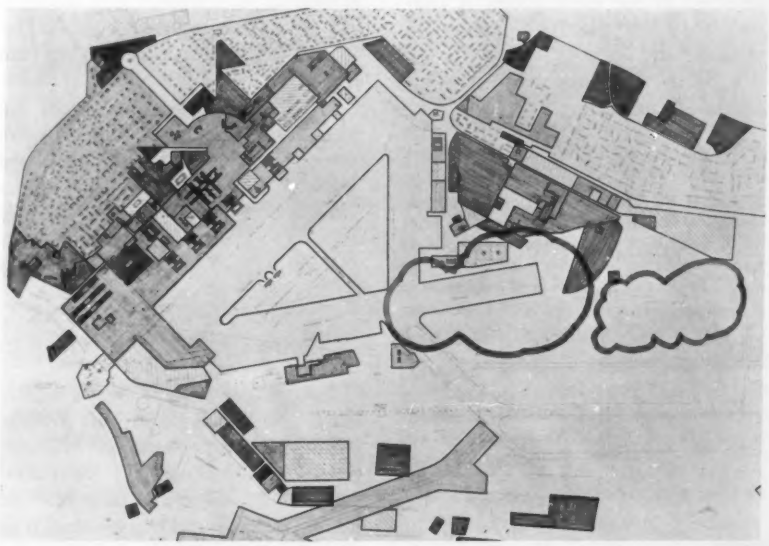
Several techniques were created to display the results of the planning and to clearly identify the phasing and progression of the master plan. It became apparent, fairly early in the game, that the conventional graphic representation, the Tab F-1 of the Base Master Plan, had shortcomings. While the F-1 is clear to base master planners, it is often confusing to many non-civil engineering personnel. Therefore, the technique of superimposing future years on the existing base plan as used in the F-1 was replaced by one which shows the phasing on a fiscal year basis.

To clearly identify projects, numbers and a three-dimensional display, using styrofoam art board, are mounted on an aerial photo of the base. A three-color scheme depicts the three phases: Planned, Under Construction and Completed. Facilities that are affected in any way by modernization, replacement or new construction appear in raised relief, while unaffected facilities are unchanged in the background. Also, wood block and artboard models were made for the community center complex, passenger terminal and the aircraft parking apron. These models were beneficial in the study of automobile and aircraft parking, as well as vehicular and pedestrian movement. The results of many of the studies, graphic displays and briefing boards were reduced to viewgraphs for presentation to large groups.

Displays Are Mobile

Another aspect of the development plan is its mobility. To convince those outside the organization and to "sell" the plan, it required that all the visual displays be mobile. The Hickam AFB Plan has been on the road more than once

CURRENT LAND USE: This is the color coded Tab C-1 of the Base Master Plan at Hickam AFB, Hawaii. It shows existing base facilities with hazardous cargo and munitions storage area which are encircled for emphasis.



for presentation of the modernization program, both in Hawaii and in Washington, D.C.

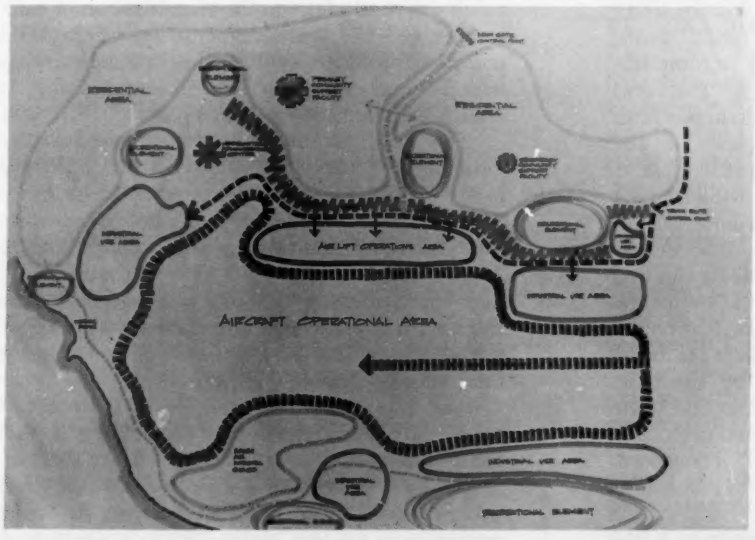
Concurrent with the modernization of Hickam AFB will be the construction of two projects adjacent to the base which will have considerable impact on the development plan. An access to the H-1 Freeway, known as the Nimitz Spur, will be jointly funded by the Federal Highway Administration and the State of Hawaii. This project will displace 37 housing units, the base bank, and change the location of the main gate. An on-base interchange will be required to adequately and safely transition the flow of traffic from base streets to the new access road.

New Runway for Airport

The other project, jointly funded by federal funds from the Airport and Airways Development Act of 1970 (PL 91-258) and the State of Hawaii, is for the development of a new runway for the Honolulu International Airport. This facility is currently under construction and is located approximately one mile south and parallel to runway 8-26, the primary runway for Hickam AFB and the airport. Known as the Reef Runway, the project involves the dredging and filling of approximately 350 acres in Keehi Lagoon to provide the support structure for the runway and part of the connecting taxiways. One building and two run-up pads will be displaced by the west access taxiway, and the southeast gate will have to be closed, since entrance to it will be cut on the State side of the airfield. Access to the golf course will be provided via a tunnel under the taxiway. Those facilities which are displaced by the highway and runway projects will be replaced in kind elsewhere on Hickam AFB, and they are considered in the development plan.

It is one thing to establish ideas on how a base is to appear at the end of a 10 year period, yet it is something else to translate those ideas into brick and mortar. But the ideas for the Hickam AFB plan are being transformed from the drawing board to the reality of actual facilities. Hangar space has been realigned by organization to conform to the aircraft parking plan, and some hangars have been converted to warehouse or administrative use. Two keystones, the west end of the apron and the passenger terminal, with exchange cafeteria, are firmly in place and operational; and two 360-man dormitories, a credit union and an auto hobby shop are now under construction. This fiscal year will see the addition of a new air freight terminal and the next increment of the new apron, as well as a communications - electronics shop, new commissary, base bank and 500-seat theater. The biggest change in the appearance of Hickam AFB is expected to occur when the first of the family housing units appear on the site of the old parking apron. Other changes this year will result from the demolition of more than 20 facilities, upgrading of the motor-pool complex, and the start of the Reef Runway access taxiway.

GENERALIZED LAND USE CONCEPT: Graphic illustration of how existing assets could be rearranged to achieve better utilization and modernization. This forms the basis for future planning and implementation.



Several Facilities Requested

The following facilities are being requested in the FY 1975 Military Construction Program: Street Interchange; Central Post Office; Dangerous Cargo Pad; Increment of Parking Apron; Aircraft Fuel System Maintenance Dock; Officer Quarters; Fire Station; Exchange Central Warehouse; NCO Open Mess; and Chapel Center.

Future years will see the construction of additional increments of the aircraft parking apron, family housing and more operational support facilities to completely implement the 10 year plan. As one would expect, these are exciting times at Hickam AFB as everyone anticipates arrival of new facilities, conversion of old ones and improvement in base activities that are assured. While this development plan and these ideas may not fit all bases in the Air Force, it has been demonstrated at Hickam AFB that it is possible to acquire the use of additional real estate without the expense of annexation or condemnation. CE

Getting together with Korean environmental officials, Kunsan AB personnel set out to ensure that Air Force efforts would not add to local pollution problems. What follows is a report on . . .

Top Center: A Korean contractor considers a solid waste generated on base as a potential resource out of place and pays cash for collecting and hauling some 900 cubic meters a month of garbage. At Right: Overall management of the protection program is the duty of the Committee made up of US and ROK units attached to the base and local Korean officials.

At Far Right: A treatment method and management policy is under study to allow discharge of wastewater from aircraft washracks to the sewage treatment plant. Bottom Center: Personnel cover windows and ventilators to conserve heating fuel resources. At Right: Creosote is applied to perimeter fenceline as a part of rodent control program

A *Successful* Environme

By Maj Sterling E. Schultz, PE

The 3rd Tactical Fighter Wing, with headquarters at Kunsan AB in the Republic of Korea (ROK), has a proud military history and tradition of accomplishment in many lands. Its presence in Korea, "The Land of the Morning Calm," is necessary to help accomplish an important mission: to promote security of the United States, the ROK and the Free World. Just as any other air base does in conducting wide-ranging activities, Kunsan AB unavoidably contributes to air, water, noise and solid waste pollution. By-products generated by aircraft operation, washracks, housing facilities and photo processing are only a few of the many pollutants created by routine air base and housekeeping activities. These sources and others are being controlled to the best extent possible by the base, without affecting mission accomplishment. The Wing feels that its responsibility in environmental protection does not end at the base's front gate and acts accordingly to ensure that Air Force efforts do not add to local pollution problems.

The Environmental Protection Committee is the manager of the Kunsan AB environmental pollution abatement program. As such, the committee devotes much time and effort in the identification of pollution sources and the initiation of action to eliminate the pollution problems so that the installation complies with Federal or Korean environmental quality standards, whichever are more stringent.

The ROK's equivalent to the United States Environmental Policy Act is Law No. 2305, **Prevention of Public Nuisances,** promulgated in early 1971. Limiting standards for quality control parameters are established by the Minister of Health and Social Affairs, ROK. Copies of the law and standards have been translated by the Judge Advocate for use by the base bioenvironmental engineer and the Environmental Protection Committee in determining compliance with applicable standards.

The Kunsan AB Environmental Protection Committee may be unique in that its membership includes local Korean environmental officials as well as representatives from US and Korean Army and Air Force units assigned or attached to the base. At times, it is necessary to conduct business bi-lingually through the

...tal Protection Program

assistance of an interpreter from the Office of Information. Each committee member is responsible for the part of the program in his functional area. For example, water pollution control from fixed facilities requires the attention of personnel in the following areas:

- Civil Engineering—programming and construction of abatement facilities.
- Waste generating facility—evaluation of on-site standard operating procedures to abate the discharge of materials that would violate pollution criteria.
- Environmental Health Services—determination of applicable standards and discharge monitoring.
- Office of Information—promotion of environmental consciousness and consideration in the organizations' day to day operations. The committee is effective because of the active participation on the part of its membership.

The practice of including Korean representation on the Committee is new, but the accomplishments of the committee date back to its establishment in November 1971. A pollution source survey conducted in 1971 identified immediate needs for environmental protection. Some of the construction projects already completed that were programmed as a result of that survey include: KUN 20-2, Vehicle Maintenance Shop; KUN 22-2, Refueling Vehicle Maintenance Shop; and KUN 78-2, Convert to Corrosion Control Facility. Others still awaiting funding are the KUN 23-2 Heavy Equipment Maintenance Shop and KUN 74-2, Convert to Fuel Cell Repair. Jet engine noise suppression facilities, recently completed and now in use, substantially contribute to the well-being of the base's nearby neighbors as well as personnel residing and working on base.

As an interim measure, until a modern wastewater treatment plant can be built, it is necessary to proceed with the rehabilitation of two sewage lift stations under Project KUN 20-3. The replacement of pumps and automatic controls in these stations will alleviate raw sewage discharges to the storm drainage system. Programmed in the FY 75 Military Construction Program is a two million dollar project to construct a 0.75 million gallons per day secondary sewage treatment system, thereby allowing abandonment of the existing system of four Imhoff and 35 septic tanks. A trickling

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Environmental Protection
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filter process is proposed for the new system including a modern laboratory for control analyses, extension of the sewer collection system and five new sewage lift stations. Since the topographic relief for most of the areas on base is less than two feet, storm water drainage is critical. To alleviate the flooding conditions during rainstorms, the project will hopefully be funded to include regrading and lining of the storm water collection system and the construction of a catchment basin equipped with diesel driven lift stations.

To the people of the ROK, pollutants are potential resources out of place, which if relocated can take on renewed value. For example, discarded materials and garbage generated on base are collected and removed by a subcontractor of the Korean Veterans' Association Welfare Service Committee. The uniqueness of this operation is that the contractor pays the US Government for the privilege of collecting and disposing of any material not required for Government use or turn-in through normal supply or disposal channels; hence there is no requirement for operating a sanitary landfill on the base. The same contactor pumps oil separators, grease traps and septic tanks when required as determined by systematic surveillance conducted by the contractor and monitored by in-house forces.

Comprehensive Plan Written

A significant and recent accomplishment of the Environmental Protection Committee was the writing of the Wing's Oil and Hazardous Substance Pollution Contingency Plan. This comprehensive plan provides for a rapid reaction capability to contain and clean up oil or hazardous materials spilled by chance. It also delineates procedures for handling or disposing of oil and hazardous materials as well as the paths pollutants would most likely use to leave the base via natural drainage courses. Since the base is surrounded by either agri-or aqua-culture endeavors, the escape of polluting substances is of extreme interest to the local people. Their governmental and environmental officials actively participated in the development of the plan and have organized their people as a part of the emergency response force in the event the seriousness of a pollution incident warrants such a response. They have good reason to be actively involved, for in 1972, the JP-4 fuel transfer pipeline between Kunsan City and the base sprung a leak and the resulting fire destroyed two houses in the village of Ok-Pong Ku.

Pest control programs on Kunsan AB are second to none. The normal operations include, among others, control of ectoparasites, cockroaches, mosquitos, tent caterpillars, webworms, locusts, crab lice, Japanese beetles and termites. Rats are a year round problem at Kunsan and in the winter of 1971 became a serious problem. They are now effectively controlled by a three-pronged attack:

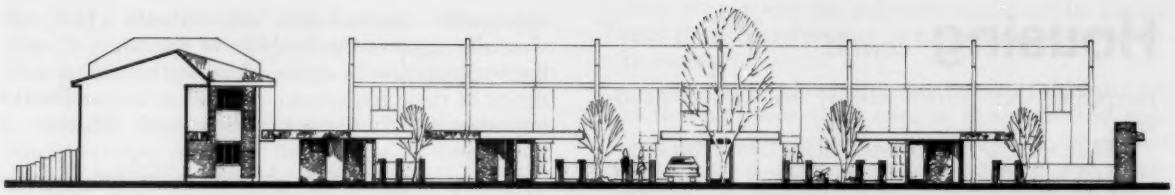
- Placement of rodent bait boxes around all buildings containing Pival and zinc phosphide rodenticides mixed with rolled oats, wheat, cornmeal, salad oil and redshade for coloring.
- Snap traps baited with bacon and cheese maintained in all dining facilities and commissary warehouses as well as along the perimeter fence; and,
- Application of creosote around the base perimeter fenceline.

Kunsan AB enjoys excellent relations with the local people of Okku County and Kunsan City. The source of the good will in addition to the Environmental Protection Committee is due in part to the effectiveness of the Korean-American Friendship Council which meets monthly and serves as a vehicle for the exchange of views on topics of mutual interest. Co-chaired by the Mayor of Kunsan City and an officer from the 3rd Combat Support Group, it is well attended by local Korean governmental officials, businessmen and commanders of the Korean and US militr y units assigned or attached to Kunsan AB. This social and business gathering heads off misunderstandings between the surrounding communities and the air base, and provides an avenue to coordinate US Air Force support for community environmental improvement projects. Kunsan City recently supplied fuel for equipment when the 3rd Civil Engineering Squadron hauled 1,200 cubic meters of sand from Mi-Myon to Kunsan City to fill pot-holed alleys.

Environmental protection is the responsibility of all Air Force personnel. The reality of this was brought closer to the individual as the Wing recently tightened its belt to conserve energy resources. Room temperatures were reduced to the range of 65 to 68 degrees and illumination levels were cut 50 percent. Government vehicle use was also restricted to authorized official duties and use during working hours only, and privately owned vehicles went on gas rationing (14 gallons per month for autos and four gallons per month for motorcycles.)

In the tradition of the 3rd Tactical Fighter Wing and indirect support of Air Force policy, significant contributions to the protection and enhancement of the environment will continue to be made at Kunsan AB in the ROK. CE

MAJOR SCHULTZ *is Chief of Operation and Maintenance, 3rd Civil Engineering Squadron, Kunsan AB, Korea. He received his bachelor's and master's degrees in civil engineering at the University of Arizona and his doctorate in environmental engineering at the University of Florida. He is a Diplomate of the Academy of Environmental Engineers and is a registered Professional Engineer in Colorado and North Carolina.*



The Best Possible in Housing

Today's military family expects and deserves decent and suitable housing that is more compatible with current military and civilian standards. Here's the latest report on efforts by the Air Force.

by Maj Richard M. Bierly, PE

This morning, as you were trying to shave in your one-bath, three-bedroom home, do you recall that your two teenagers, who were getting ready for school at the same time, gave you "only two seconds" to use the bathroom? Then, after slipping downstairs for the morning cup of coffee, you were greeted by your wife with some mumblings about the kitchen, that there was no place to work and that there were some remarks about not having a dishwasher? As you sipped on your coffee, you thought to yourself that when you get home this evening, you will be able to carry on an intelligible conversation with your neighbor through the well-defined "party wall," whether you want to or not.

If this has a familiar ring, the chances are quite good that you and your family live in on-base housing that is probably more than 10 years old. As a matter of fact, four out of every five houses in the Air Force inventory are more than 10 years old. World-wide, the Air Force owns some 142,000 family housing units. Of this total inventory:

- 27,000 are Wherry homes built between 1948-1954;
- 55,000 are Capehart homes built in the mid-and late 1950s; and
- 60,000 homes are military construction program housing, some recently constructed, but others dating back more than 80 years.

MAJOR BIERLY *is an Architect-Engineer, Housing Division, Directorate of Civil Engineering, Headquarters US Air Force, Washington, DC. He received his bachelor's degree in architectural engineering at Pennsylvania University and is a registered Professional Engineer in Pennsylvania.*

The Air Force has recognized that a definite inequity exists between these older homes and those built in recent family housing construction programs. This inequity, and therefore the need to improve these homes, stems from two primary sources:

One: the need to provide amenities not included in the original construction because of budgetary constraints and Congressional limitations;

Two: to generally upgrade these older homes to a standard that is more compatible with current military and civilian housing construction.

The P-713 Post Acquisition Construction Improvement Program is the Air Force program that has been tasked to eliminate this inequity. The objective is to consolidate appropriate modernization requirements into a project which substantially improves the livability of the homes within the constraints of statutory cost limitations.

You may be thinking right now that the P-713 Program has been around for years. You are right. It is not a new program, and it has been around for awhile. However, let's take a look at how the P-713 Program has worked in the past. Basically, it provided token improvements at a large number of bases using what might be termed a "scatter-gun" approach. For example, your base housing may have received garbage disposers one year, dishwashers the next, more storage space another year, nothing the next, and so on. This approach was an attempt to provide more livable homes for **all** families and, needless to say, it fell short of this goal in our older homes. Both the improvements that could be provided at any one time and the size of the program produced an end product that was less than desirable.

With the ever-increasing age of Air Force housing and the lack of amenities provided during construction, it became obvious that a new program concept was needed to truly improve the Air Force family housing inventory. Today's military family expects and deserves decent and suitable housing that is more

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Housing *cont'd*

compatible with current military and civilian standards.

What, then, is the Air Force doing about this situation and how does it affect you, either as a member of the Base Civil Engineering organization or as a military family living in Air Force housing?

First, the P-713 Program funding has significantly increased this year. Program funding for FY 1974 was approved at over $23 million, almost doubling the near $12 million in FY 1973. This means that considerably more homes may be improved.

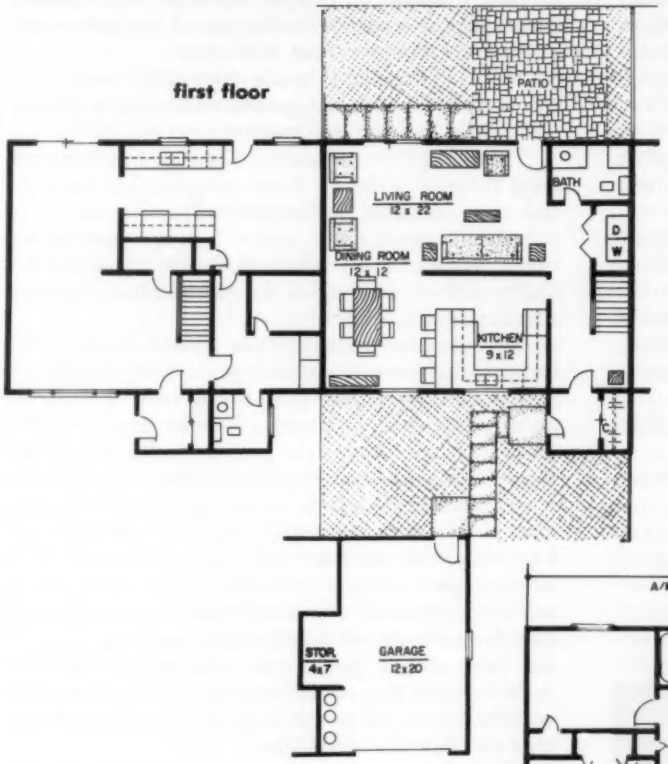
However, just as important as the proposed funding, is the revised design concept and approach employed at this time. It is this feature which impacts directly upon you as a designer in the Base Civil Engineering organization or as a resident of Air Force family housing. As you may recall, it was previously stated that the current P-713 Program is to **consolidate appropriate modernization requirements which substantially improve the livability of the home.** Clearly, the emphasis now is on the identification and consolidation of those requirements necessary for **substantial** improvements in the acceptability and livability of the home.

The genesis of this program objective and the testing of the design concept to achieve this objective was first used in the FY 1973 P-713 Program at Billy Mitchell Village, Kelly AFB, Texas. Looking at the design concept that has evolved from the Billy Mitchell Village housing project will provide a much better understanding of the impact on you as a design engineer or as a future occupant of one of these homes.

The revised P-713 design concept addresses three areas of improvements:

- Analysis of Asset/Unit Functional Deficiency;
- Family Livability; and
- Related Maintenance and Repair.

Looking at each of these improvement areas in more detail will provide some insight into the magnitude of



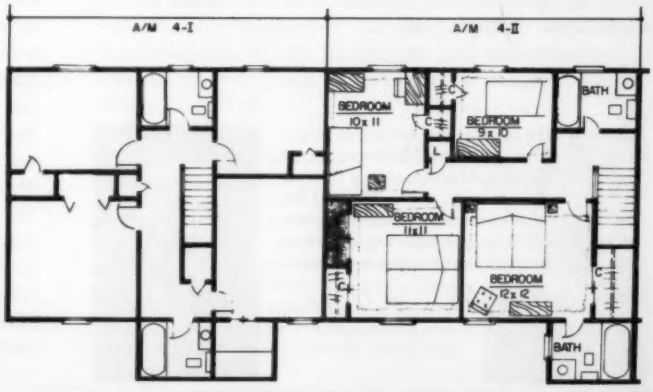


Figure 1:
Modified plans for an Airman Four-Bedroom Unit will have such improvements as an increase in living area to 1,310 square feet, an increase in square feet for the dining and living room areas, foyer arrangement changes, over 170 square feet of bulk and interior storage, a full bath added, one bedroom increased in size, and kitchen modifications for increased shelving, counter top area and drawer space.

the design decisions that must be made. These decisions require high level, professional judgment to be exercised by all persons concerned with the program at all levels of command.

Initially, it is necessary to review the existing family housing assets as they relate to the housing composition requirement (grade and number of bedrooms per unit). For example, if you have 200 airman two-bedroom homes, but the need is for 150 airman four-bedroom homes, there is little sense in improving all of the two-bedroom units in their present configuration. The design concept objective is, therefore, to realign the existing two-bedroom homes to more suitably satisfy the deficiency in four-bedroom homes. Concurrently, the functional arrangement within the home must be realized and analyzed. Many of the older homes have poor functional arrangements and do not provide living areas that are considered a part of current, acceptable criteria or standard of living.

Based upon this review and analysis, several courses of action may be possible. Where a deficiency exists in either the housing composition or the functional arrangement, several methods are available to provide a satisfactory solution: (1) The construction of building additions; (2) The combining of several smaller row-type homes into one larger home, for example, combining two adjacent two-bedroom units into one four-bedroom home; or (3) The rearrangement of the interior configuration. If no composition deficiency exists, but the net area of the unit is less than currently authorized, the home may be reclassified. For example, a 980 square foot, three-bedroom home might be redesignated a two-bedroom home, providing no deficit exists on the base for three-bedroom homes.

Concern for Livability Characteristics

Once the solution to achieve the most acceptable project composition and functional arrangement has been determined, the remaining efforts are directed at providing those improvements which will enhance the livability characteristics of the home for the family. The following improvement areas are those which directly affect the acceptability of the home. Each item would be incorporated in the design solution where the deficiency exists: air conditioning (where authorized); kitchen modernization; bathroom (both modernization and additional facilities); privacy (both visual and acoustical); laundry facilities; bulk storage (both interior and exterior); carports (garages where authorized); and sitework and landscaping.

Understandably, with any renovations or improvements, additional maintenance and repair work can be identified which is most economically accomplished in conjunction with the related improvements. However, due to the objective to achieve substantial improvements and modernization, the maintenance and repair work considered for accomplishment is only that which is an integral part of the improvement requirement. Maintenance and repair work which does not support this objective would not be considered for accomplishment in conjunction with the improvements.

By now, you have probably surmised that arriving at the most acceptable solution is not an easy task. It requires considerable professional judgment on your part to refine the requirements identified into an acceptable solution within the constraints of the actual field conditions. The designer must continually weigh his engineering decisions against the architectural considerations to arrive at the most satisfactory and economical solution possible.

An example of the results of this design concept can be seen in **Figures 1 and 2.** Upon investigation, you must agree that the Air Force is indeed embarked on a program that does substantially improve the livability of your future home. However, this will be possible only if each and everyone associated with this program is willing to do his job. Only in this manner will the Air Force continue to lead the way in providing the best possible housing for its people. CE

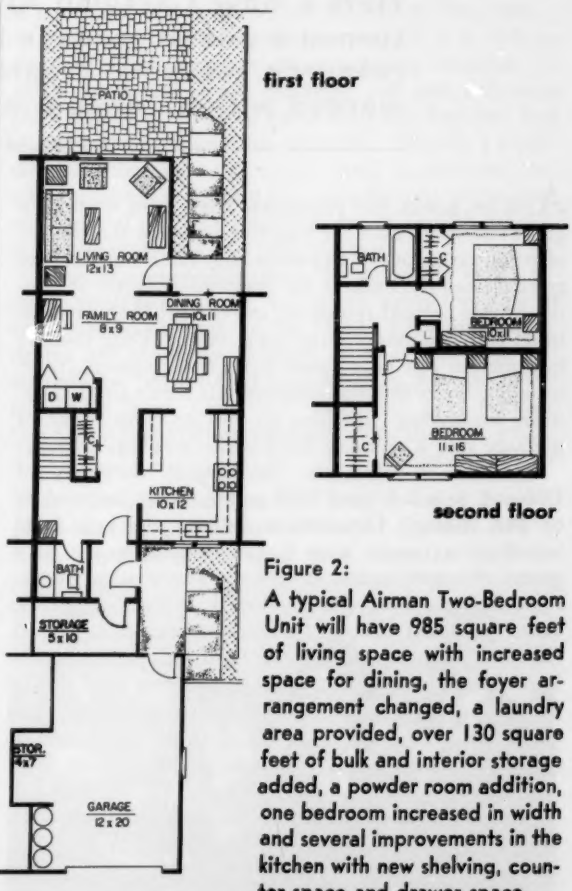


Figure 2:
A typical Airman Two-Bedroom Unit will have 985 square feet of living space with increased space for dining, the foyer arrangement changed, a laundry area provided, over 130 square feet of bulk and interior storage added, a powder room addition, one bedroom increased in width and several improvements in the kitchen with new shelving, counter space and drawer space.

RECYCLING DOES WORK!

Here's how Carswell AFB, Texas Civil Engineers turned a pile of garbage into a working solid waste resource recovery program. Their efforts were rewarded with a "Keep America Beautiful" award.

by David B. Sussman

Articles, books and pamphlets have been written in great quantities over the past few years on the subject of resource recovery and recycling. Each outlines the critical need to conserve the dwindling supply of non-renewable natural resources and the problem of what to do with the mountain of solid waste. While useable information can be gleaned from these sources, none usually answer the question that Air Force Civil Engineers are asking. Just how do you go from a pile of garbage into a working solid waste recovery system?

William P. Clements, the Deputy Secretary of Defense, in a 1 August 1973 memo to the Secretaries of the Military Departments, stated that all DoD installations would soon begin comprehensive programs of waste matter recycling. The success of the Pilot Recycle Program developed at Carswell AFB, Texas, no doubt affected his decision because it proved that a workable program can be developed. An outline of the planning and operating factors used in the development of the Carswell Resource Recovery Program follows, and it may be of great assistance to other Air Force bases who are planning their own operations.

The first step in any problem solving scheme is to define the problem. What is "Recycleable Waste" and how is it taken out of the garbage can and into the secondary material stream to be reused in the manufacture of goods? To arrive at the solution, one must determine objectives of the program. Those used at Carswell AFB include:

- To find markets for the recycleable materials in the base solid waste;
- To develop a system that would have as little impact on the normal operation of the base as possible;
- To make the system cost-effective;
- To reduce the loading on the base landfill by at least 25 percent, and
- To educate the base citizenry to a new environmental ethic.

These objectives can be used to construct an orderly, time-sequenced plan that hopefully will result in an effective recycle program. Planning is all important. Solid Waste Management Planning is as complex as any military operation and must be attacked with vigorous effort. There is no need to build a new "SIOP" around the garbage problem but the same type planning techniques do work.

The next step after the objectives have been determined is to analyze, with some accuracy, the solid waste that is generated on the installation. One must know the weight, volume and composition per unit time at this point in the planning sequence. The easiest way to establish a garbage data base is to look at and weigh garbage. Study the waste generated by

a few families in the housing area; see what goes into the dumpster at Base Operations; what is delivered to the landfill site; where it came from. Find out who are the larger waste generators. For example, a commissary will throw away one ton of recycleable corrugated cardboard for over $25,000 of gross sales. Surveys in the past indicate that the recycleable waste at a base is made up of rougly 70 to 90 percent paper, 8 percent ferrous cans, 9 percent glass containers, and 1 percent aluminum.

Now that how much and what is known, the next step is to find the markets. All waste material generated on a military installation is "Surplus Government/ Personal Property" and must be sold through the base's local Property Disposal Office (PDO). The PDO and the Defense Property Disposal Region (Defense Supply Agency) have the responsibility of selling this material, but because recycleables have low value per unit weight, the local PDOs sometimes are not too enthusiastic about doing detailed market surveys and finding buyers. Therefore, the recycle planner must find his own markets and "hustle" his wares. These available markets can then be presented to the PDO/DPDR for sales contract.

A market survey of the local area to locate buyers of recycleables can be performed with little difficulty. First, look for scrap dealers in the yellow pages of the telephone directory. Check with local business groups to see who buys paper stock (scrap paper), etc. Find manufacturers that make goods from secondary materials. The possibilities are endless. If no local (within 50 miles) markets exist, look into the possibility of shipping to the closest buyer outside the area. With the cost of scrap paper today, a base can bale and ship paper stock cross-country and still make money.

During coordination with the buyers, the recycle system will begin to take shape. How must the material be separated? How prepared? How picked up or delivered? What amount will be paid? What kind of sales contracts will be necessary? Here comes the first big decision. Paper stock is bought in various grades. Will the buyer take all paper as "mixed" or will he require separation by grades, that is, corrugated, ledger, bond, etc. Computer and ledger paper bring very high prices per ton, but what will it take to keep it separated? Remember the objectives: Cost effectiveness and reduce landfill loading. If a base only sells computer paper, it may be cost-effective but what about all the rest of the paper? Maybe it would be better to sell the paper as mixed for a low price but sell it all. Remember money is not the only reason for doing things.

The next step involves separation and collection planning. Solid waste is not homogeneous as it is generated, so a separation scheme is necessary to separate the recycleables by type. Someday there will be post-collection resource recovery machines that will do the separation and preparation, but until then, the only logical way to separate the recycleables is prior to collection, at the source. This "Separation at the Source" method is very simple and relies on the individuals who generate the waste to separate it into the various categories for collection. The secret of a successful recycle effort is education. The education process is all important and some ideas on how this is accomplished are covered later.

Collecting the separated waste is normally accomplished by using one of two methods: the recycle center, where the recycleables are brought in by personnel; and route collection, where recycleables are collected much in the same way as refuse. The recycle center is by far the simplest and least expensive to operate but it is very ineffective. Most recycle centers, no matter what the size, recycle less than 5 percent of the total waste generated in the area they serve. Although some recycle centers in metropolises handle a tremendous volume of material, percentage wise, they do not make too big a dent in the solid waste problem. Small, efficient recycle operations have a greater ecological impact on a given area, therefore, a route type collection system is preferred. Studies have indicated a direct relation between convenience of collection and percent of participation. In other words, if personnel find it convenient to recycle, they will.

The most effective collection method is to pick up material from every waste generating location. In many cases this is not practical, and one collection point may have to serve more than one location, that is, one collection point for 10 houses. There is a trade-off point that will still insure good cooperation, yet allow effective collection and consolidation. This point will depend on the population density, waste generation rate, materials and other factors.

The equipment necessary to support a base's recycle operation will be dependent upon the type of collection containers to be used. Fifty-five gallon drums are attractive because of their low cost and availability; but if full of crushed glass, they are heavy to lift by hand. Open-end drums are best because there is no preparation required before use. The small-

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Shirley Temple Black presents Keep America Beautiful silver bowl to Col A. B. Curfman of Carswell AFB as R. P. Davidson, publisher of Time magazine, looks on.

RECYCLING

cont'd

est practical collection container for paper would be a one-cubic-yard, closed-top box, either steel, fiberglass or wood. Some buyers require that the waste paper be kept dry, and weather proofing may be necessary. Large quantities of paper stock that must be moved over considerable distances should be baled. Balers can be rented, purchased or obtained from the paper buyer (if volumes warrant).

The best system for loose paper collection is a "front end, over the cab load," refuse truck and many small containers (two to six-cubic-yard boxes). This equipment is in the Air Force inventory as the "Lodal" system. Rear-end load residential refuse trucks are good for route collection of bundled paper products.

Equipment available to collect material from 55-gallon drums is varied. Any type of truck can be used, like a pickup, dump truck, enclosed van or refuse truck. All of these vehicles require hand lifting of the drums. This is not a problem if collection is often enough to prevent full drums of crushed glass. The best vehicle available today to collect recycleables from 55-gallon drums is a fifth-wheel, trailer mounted, compactor with a drum lifter. A vehicle of this type can be towed by a pickup truck, is small enough to maneuver in close quarters, is self contained and totally enclosed. The drum lifter will enable full drums to be collected and the compactor feature will reduce the volume of the recycleables. The vehicle used in the Carswell AFB program was manufactured by Dempster Bros. Cleburne, Texas, cost under $10,000, and was bought through a lease purchase plan direct from the manufacturer. The equipment selected will depend on funding, surplus acquisitions, lease availability and the size recycle operation anticipated. Flexibility is extremely important in this area, as participation and volume of materials are available.

Recycle System Like Any Business

Who will run the operation? Volunteer recycle programs tend to be short lived and are plagued with other problems. A good recycle system must be manned and operated like any business or base O&M support function. Manning and management should be similar to conventional refuse collection and disposal systems with one difference. The waste is sold, not just thrown away, and money is returned to the base. The Carswell AFB program is manned with four full-time employees, two military and two civilians.

Now for the catalyst – education. Citizen cooperation is extremely important in order to get a separation at the source recycle program to work. The author firmly believes that education – rather than regulation – will produce the type of cooperation necessary for a workable recycle program. Actual experience has shown that voluntary participation will produce effective results. Therefore, extensive education, advertising and public relations campaigns must be undertaken. In a closed community, like an Air Force base, information about a program is fairly easy to disseminate. No one medium is effective by itself; but when all outlets are used in a concentrated effort, outstanding results can be obtained. A good program should lean toward the reasons why recycling is necessary. If people can be made to understand the environmental problem, they will be more willing to work to improve it. Although recycling is only a small part of the total ecological crisis, it is a starting point and offers individuals a personal involvement in environmental enhancement.

Available media to disseminate this education are base newspapers, daily bulletins, bulletin boards, base-wide distribution of letters and brochures, etc. Briefings at commander's calls, staff meetings, wives' club meetings, service group meetings and other gatherings are most effective (person-to-person contact is important). Radio and TV spots are usable at locations that have these outlets. Many service organizations can be enlisted to help spread the word. Scouts, Junior Officer Council, and family service can prove helpful.

Run the advertising/education campaign just like "Madison Avenue." The concept is to sell and the same techniques that are used on TV to sell deodorants will work to sell ecology.

Recycling does work. There are systems within the military which are functioning today that were designed under the guidelines in this article.

DAVID SUSSMAN *was an Executive Support Officer with the 7th Civil Engineering Squadron at Offutt AFB, Nebraska, prior to his recent retirement. He is now with the Resource Recovery Division of the US Environmental Protection Agency in Washington DC.*

A good resource recovery program at your base can:

- Be built to run at less cost per ton than your conventional waste disposal scheme;
- Can earn money enough to break even in a few years;
- Can reduce landfill loading by 40 to 50 percent;
- Can create a very pro-environmental atmosphere; and
- Can show that there are people who, instead of only talking about the ecological crisis, are willing to do something about it. CE

The growth in size of aircraft over the past few years has had a significant effect on airfield pavements. For the Air Force, the problem is not how to design and build new pavement, but how to take care of the 500 million square yards of pavement it owns.

AIRCRAFT TECHNOLOGY *vs.* PAVEMENT TECHNOLOGY

by Maj Robert E. Boyer, PE

Air transportation has grown more rapidly in this country than any other mode of transportation during the past two decades. The numbers, types and kinds of aircraft have increased by multiples, aircraft operations have grown almost without bounds, and the gross weights of both military and commercial aircraft have jumped from 30,000 pounds in 1935 to more than 800,000 pounds today. Conversely, most of our existing airfield pavements were designed and constructed prior to 1955 when aircraft gross weights were less than 400,000 pounds. Soon, jumbo jets will be tipping the scales at one million pounds, that is, if the philosophy of "stretching" aircraft continues. For example, the Boeing 707 or Air Force C135 weighed approximately 250,000 pounds when it first was introduced; now, it commonly tips the scales at 325,000 pounds.

The impact of the growth in size of air transport vehicles has had a significant effect on all airports. An article entitled "Deteriorating Airport Pavements Spur Efforts to Head Off Crisis" in the 4 November 1971 issue of **The Engineering News Record,** emphasizes efforts by the Federal Aviation Agency to conduct a $3 million research effort to cope with the situa-

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PAVEMENT *cont'd*

tion. It cites examples of construction undertaken and reports on a few major airports which anticipated the problem:

- San Francisco International Airport recently completed a five-year $3.25 million beefing up program.
- Tampa International Airport recently opened a new terminal and 90 acres of thick concrete aprons, and it is now investing $3 million to rehabilitate a World War II runway and is closely monitoring others.
- The Los Angeles Department of Airports plans to rebuild its complete airport pavements at a total cost of $21 million.

Practically all major civilian airports have similar construction and rehabilitation programs. The Air Force is currently in need of major rehabilitation programs as well.

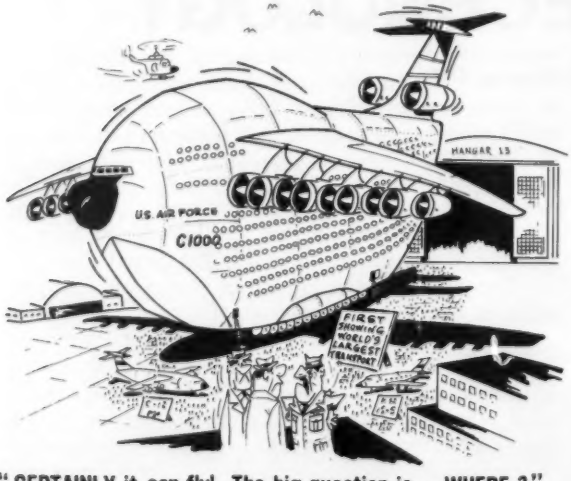
A Runway From Washington to Florida

The Air Force owns over 500 million square yards of pavement. Runways, taxiways and parking aprons alone have a total surface area equivalent to a 200 foot wide runway stretching from the State of Washington to the southern tip of Florida. For an average Air Force base, this amounts to roughly 500 acres of pavement. These pavements represent nearly 40 percent of all funds spent for support facilities. The replacement cost at today's construction prices is approximately $7.5 billion. Cost figures would significantly increase if they would include pavements owned by other branches of the United States armed forces.

It is anticipated that aircraft operations will increase at our major Air Force bases, predicted on:

- **Vietnam Situation:** The pullout from Vietnam is complete. The war in Southeast Asia has promise of winding down in the future. Many US aircraft have, and will continue to return to stateside bases.
- **Mobility:** The Bare Base concept is starting to materialize. Exercises are essential, and large aircraft will have to be deployed.
- **Guard and Reserve:** The increased role of both the Air National Guard and the Air Force Reserve means heavy weekend traffic with greater utilization of military pavements.
- **Base Closures:** Primary missions from defunct Air Force installations are being relocated to active bases, thus increasing operations at bases not affected by the closures.

It is obvious that with the importance of the Air Force's pavements as a real estate facility, their maintenance and upkeep cannot be neglected; yet, their future care could well find Air Force Civil Engineers with a problem of greater magnitude than anticipated. Operations are assumed to become greater in number for in-place pavements. Aircraft gross weights are twice that of the aircraft for which the pavements were initially designated. As a result, the majority of Air Force pavements are somewhat antiquated, and the problem becomes **not how to design and build new pavement, but how to take care of what we have.**



"CERTAINLY it can fly! The big question is ... WHERE ?"

MAJOR BOYER *is a Course Director, Department of Engineering Technology, Civil Engineering School, Wright-Patterson AFB, Ohio. A graduate of the University of Kentucky, he was awarded his master's and doctorate degrees from Purdue University. He is a registered Professional Engineer in Kentucky.*

In order to assess how existing pavements will perform in the future, it is necessary to study the design methods and underlying assumptions, which establish the criteria for the pavement itself. In the case of a flexible pavement, the classical theory of elasticity forms the basis for thickness design. The flexible pavement thickness is designed to insure that the deflection in the subgrade is limited to a reasonable value. The major assumptions in this theory are that the subgrade, base course and wearing surface are homogenous, isotropic and obey Hook's law, that is, stress is proportional to strain and Young's modulus is a constant. The boundary loads, or tire footprints, applied to the semi-infinite mass of the subgrade and pavement materials are assumed to be static. In the case of a rigid pavement, the theory of elasticity is again invoked, but in a different manner. In this case, the Portland Cement Concrete (PCC) is taken to behave as an elastic beam supported by a fluid pressure (com-

monly referred to as the modules of subgrade reaction). The rigid pavement thickness is designed to insure that the PCC does not rupture incident to aircraft applied boundary loads. The PCC is assumed to be homogenous and isotropic, and that it should obey Hook's law just as in the case for flexible pavement layers. The boundary tire loads are also assumed to be static.

Inertia Forces Cannot Be Neglected

The pavement engineering community recognizes that the pavement material assumptions related to homogenity, isotrophy and elasticity are not valid for soil and common pavement materials; however, the theory of elasticity, plus consistent experience, has permitted us to **build pavements with some degree of confidence.** The same community, however, is currently expressing concern over the static load assumption because of the large aircraft masses associated with the introduction of jumbo jets. It is the contention of a number of practicing pavement engineers that inertia forces (mass x acceleration) can no longer be neglected. If this contention is proven to be true, then the assumption of static boundary forces in the pavement design model can no longer be tolerated in pavement analyses.

The current design concepts for both flexible and rigid pavements are predicted on application of statically applied loads. These concepts require the pavement to merely resist the weight of the aircraft at rest, as shown to the left in **Figure 1.** Should dynamic loads become a governing factor in the design of a pavement, then the pavement must be designed to resist the weight of a particular aircraft, plus the magnitude of an inertia force (equal to the product of the mass of aircraft/pavement system and the vertical acceleration of the aircraft/pavement system itself), as shown to the right in **Figure 1.**

Tests Conducted to Measure Inertia Force

To obtain a measure of this inertia force, the vertical dynamic displacement of a C135 aircraft was measured during tests at Kirtland AFB, New Mexico in early 1972. From these measurements, it was concluded that the vertical acceleration was approximately .2 feet per second squared. From other test results, it was concluded that the vertical pavement acceleration for a C-5 aircraft on the same pavement would have been approximately .6 feet per second squared at the same forward speed. These accelerations of the aircraft/pavement system, coupled with a conservative estimate of the mass of the system, permitted a calculation of the respective inertia forces, **Figure 2.** In the case of the C135 aircraft, the inertia force amounted to 30,000 pounds, whereas, in the case of the C-5, it amounted to 300,000 pounds. As depicted in **Figure 3,**

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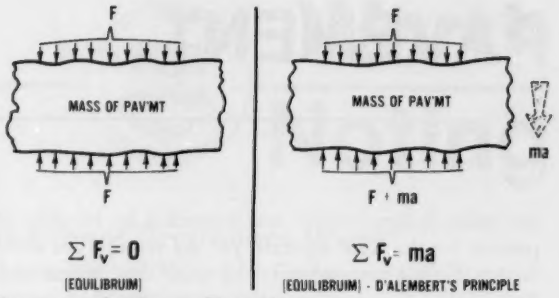

Figure 1: Statics vs. Dynamics.

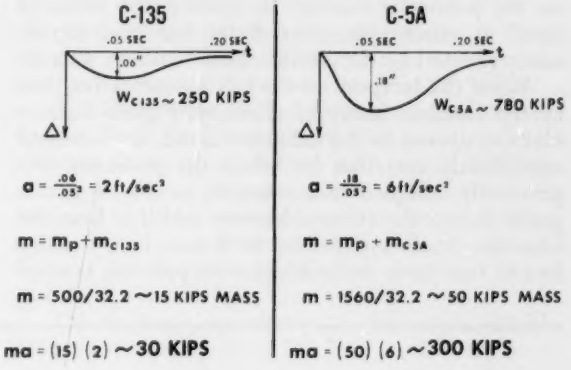

Figure 2: Comparison of Inertia Forces.

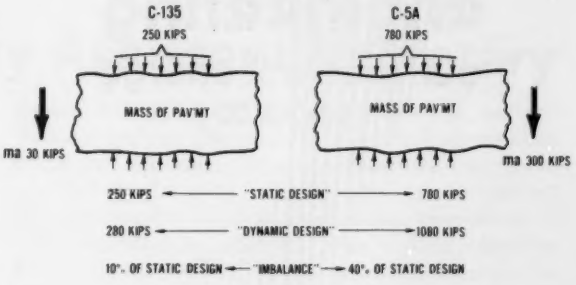

Figure 3: Statics vs. Dynamics.

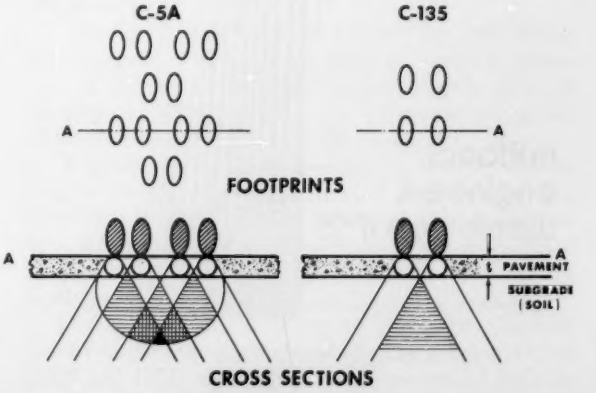

Figure 4: Stresses in Subgrade Layers.

PAVEMENT *cont'd*

the static design criteria was exceeded by roughly 10 percent for the C135 aircraft; yet, for the C-5 the static design criteria was exceeded by more than 40 percent. Essentially, this confirms the contention that inertia forces demand consideration in design of pavements for the jumbo jet aircraft. In essence, the factor of safety in current pavement design has been significantly reduced by the introduction of massive aircraft.

When the footprint of the C-5 aircraft is analyzed by the classical theory of elasticity, **Figure 4** shows that the stresses in the subgrade layers are increased significantly over that for which the pavement was previously designed. For example, in the deep subgrade layers, the stresses become additive from the boundary loads imposed by 10 tires in lieu of either two to four tires encountered with previous conventional aircraft configurations. This phenomena was derived through a concept that tire pressures were the governing factor, rather than the distribution of stresses in a layered medium. This increased stress is a matter of concern because it is applied in a medium that possesses weakest strength characteristics. This condition will lead neither to immediate nor catastrophic failures, but it will cause a more rapid deterioration of existing pavements—even without consideration of any inertia effects imposed by the greater mass associated with the aircraft/pavement system.

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Pavement Technology Surpassed

Considering the increase in number of aircraft and aircraft operations, plus the larger weight of the new generation aircraft, it is now apparent that vehicle technology has surpassed pavement technology. This statement has now become a reality, but not without hope! Leaders in the pavement technology area have recognized the problem, and have appropriated substantial research dollars in an effort to conceive methods to better evaluate the effect of modern aircraft operations on our somewhat antiquated airfield pavements. New theories are being advanced. For example, the Federal Aviation Administration and the Departments of the Army, Air Force and Navy are currently engaged in research efforts to achieve equilibrium between aircraft design and pavement design. The efforts include (1) a theoretical solution to the classical theory of elasticity with the inertia force being considered; (2) application of transfer function theory which incorporates the inertia force; and (3) consideration of energy concepts that include the mass of the aircraft/pavement system. All of these programs introduce a concept of non-destructive testing predicated on time-dependent, or inertia force, orientated methods of testing. These contrast with the commonly accepted impirical techniques in existence today, and it is anticipated that one or more of these efforts will become operational before 1975.

Solution Lies in Current Research

It is reiterated that the problem facing the Base Civil Engineer (BCE) and his pavement engineer is not one of how to design new pavements, but rather, one of how to upgrade and/or maintain the pavements that currently exist. The ultimate solution lies in the success of current research, and its end products. In the interim, the only solution is **close surveillance coupled with good engineering judgment**, while appraising our leaders of the magnitude of the pavement problem. Sound leadership, backed by technical expertise, good judgment and concrete justification are the only means for obtaining funds in support of needed pavement projects. So, the BCE and his pavement engineers must insure that their pavements are up to par. **CE**

Worth Noting

Brig Gen Robert C. Thompson Named Deputy Director

Brig Gen Robert C. Thompson, currently the Deputy Chief of Staff for Engineering and Services, Headquarters United States Air Forces in Europe, Ramstein AB, Germany, becomes the Deputy Director for Civil Engineering at Headquarters US Air Force on 1 May 1974, it was announced recently.

Civil Engineering School Seeks Qualified Instructors for CY 1975

The Civil Engineering School, Air Force Institute of Technology, Wright-Patterson AFB, Ohio, will have six vacancies for instructors in the summer of 1975. Volunteer officers who have a master's degree in electrical engineering, mechanical engineering, civil engineering and industrial engineering, in addition to about 10 years of Air Force Civil Engineering service, should contact: The Director, Civil Engineering School, AFIT/DE, Wright-Patterson AFB, Ohio 45433.

National Engineers Week Luncheon Set for February 22

The National Society of Professional Engineers, sponsors of the annual National Engineers Week observance, announced that the 1974 theme is "Engineering . . . Our Greatest Energy Resource." The 24th National Engineers Week will be February 17-23.

The Directorate of Civil Engineering will sponsor the Air Force Civil Engineering Day Luncheon at the Officers' Open Mess, Bolling AFB, on 22 February. At the luncheon, announcement is made of the military and civilian winners of the Meritorious Achievement Awards for Professional Excellence; the Air Force Civil Engineering NCO of the Year Award; and the Foreman of the Year Award.

The Air Force Association, in conjunction with the Directorate, will present the Best Author Award to the author selected from a group of writers who have had articles published in the **Air Force Civil Engineer** journal during 1973.

Crockett Named Deputy Assistant Secretary

Rufus L. (Davy) Crockett

Rufus L. (Davy) Crockett was named Deputy Assistant Secretary of the Air Force (Installations) on 4 December 1973.

Well known among Air Force Civil Engineers world-wide, Mr. Crockett had served in varying positions of importance within Air Force Civil Engineering for over 18 years. This latest promotion is yet another step in an already distinguished career.

Mr. Crockett's Government service began with the Army Corps of Engineers in 1940 where he served as an officer in the US Army after graduating from Officer Candidate School. He resumed his Civil Service career with the Office of the Chief of Engineers, US Army, in 1946, and in 1954, he transferred to Headquarters US Air Force, where he served in key positions within the Directorate of Civil Engineering until 1959.

From 1959-62, Mr Crockett served with the Aerospace Defense Command in Colorado and with the Ballistic Systems Division of Air Force Systems Command in California. He returned to the Directorate of Civil Engineering in 1962, serving as Associate Deputy Director for Civil Engineering Operations. In 1967, he attended the Air War College Resident Course at Maxwell AFB, Alabama, and returned the next year to the Directorate of Civil Engineering. In 1969, he was named Associate Director of Civil Engineering.

Mr. Crockett was named Deputy for Installations Management, Office of the Deputy Assistant Secretary of the Air Force (Installations), in July 1972. By October of that year, he was promoted to Acting Deputy Assistant Secretary (Installations).

A graduate of the University of South Carolina with a bachelor's degree in civil engineering, Mr. Crockett is a member of the American Society of Military Engineers and the American Institute of Plant Engineers. He is a registered Professional Engineer in Colorado.

During his service with the Air Force, Mr. Crockett twice received the Exceptional Civilian Service Award (1965 and 1972), the highest Air Force award for outstanding achievement.

In complying with Federal, State and Local pollution regulations, here is an example of how the Air Force is cooperating with the Environmental Protection Agency in protecting the environment while meeting the nation's energy needs.

Leading the Way In Pollution Abatement

by William D. Goins, PE

As the result of the energy crisis and problems associated with pollution controls, Department of Defense (DoD) installations are confronted with complying with stringent Federal, state and local pollution regulations. The Environmental Protection Agency (EPA), in addressing standards of performance for new stationary pollution sources, has required the states to file implementation plans which include control of most other pollution sources. Stationary fuel combustion contributes 75 percent of the sulfur dioxide and 22 percent of the particulate matter emitted into the atmosphere. One quarter of the sulfur dioxide and one third of the particulates from stationary fuel combustion are produced by industrial boilers which are prevalent in Air Force facilities.

Efforts by the Air Force to reduce emissions from these boilers to comply with pollution criteria has entailed, in most cases, the conversion from coal-fired to gas or oil-fired boilers, whichever was determined the most economical. Over 50 Air Force heating plant conversion projects have been included in the Military Construction Programs from FY 1968 to FY 1973. However, because of the energy crisis, which emerged in the winter of 1972, the Assistant Secretary of Defense for Installations and Logistics, established a moratorium on all proposed conversions of boilers or hot water generators greater than 10 mega BTU per hour output from coal to another fuel. Gas and oil are both in short supply throughout the United States. Therefore, coal must be used as the primary fuel for central heating plants at DoD installations. Air pollution regulations in most areas limit sulfur dioxide emissions as well as particulates, resulting in a high demand of low sulfur coal and a correspondingly high price.

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Air Force Cooperates With EPA

Results of all of these factors caused the Air Force to seek other means of complying with the pollution criteria while also avoiding supply shortages. The EPA has been investigating different pollution abatement systems for installation on industrial size boilers and has recommended a system developed by A. B. Bahco of Sweden. The EPA position on this technology is documented in the Federal Register, Volume 37 No. 55 – Tuesday, March 21, 1972. Presently, 17 of these Bahco units are installed or are planned for installation in Sweden and Japan. EPA approached the Air Force as well as other governmental agencies and private industry about installing a Bahco unit for demonstration in the U.S. Based on the Air Force's desire to cooperate with EPA in protecting the environment while meeting the nation's energy needs and the mandate for leadership in pollution control as directed by Executive Order 11507, the quest for a demonstration facility commenced in cooperation with EPA.

The central heating plant at Lockbourne AFB, Ohio was selected for the demonstration installation. The factors which influenced the decision to install the system at Lockbourne AFB included:

- The Defense Fuels Supply Center reported there

may be difficulty obtaining the quantity of fuel oil necessary.

- High sulfur coal was readily available.
- The Bahco system will meet local air pollution control criteria with a minimum of operational difficulties.
- Initial construction costs will be approximately the same as those of the proposed fuel conversion.
- The annual operation and maintenance expenses will be about the same as those of the converted plant, based on presently-known fuel costs of $11.74 per ton for high sulfur content coal, $23.80 per ton for low sulfur content coal and $0.145 per gallon for fuel oil.

The plant at Lockbourne AFB is equipped with seven spreader, stoker fired, high temperature water generators having a total output capacity of 218.4 mega BTU per hour which is within the size range EPA required for a successful demonstration.

The major functions of the Bahco system are illustrated in **Figure 1.** Flue gas is supplied by a forced draft fan with a typical draft control mechanism. A secondary damper which admits make-up air automatically, maintains optimum gas flow in the scrubber during varying boiler operations, and is connected to the vacuum side of the fan.

Flue gas is forced into the scrubber inlet (1) where it is distributed and directed against the surface of a hydrated lime slurry. There the flue gas reverses direction and enters the first venturi stage (2). The gas-liquid contact creates a vigorous cascade of droplets.

Because of the high flue gas velocity in the column inlet, the droplets are transported through the venturi scrubber at a high concentration and turbulence. The droplets are separated from the flue gas in a centrifugal drop collector (3). Liquid is returned to the first stage contact zone and the gas passes to the second stage venturi (4) where the gas-liquid contact process is repeated.

Gas Exits Through Stack

In the second stage drop collector (5), the gas becomes free of droplets and exits through the stack (6). The scrubbing liquid (13) is recirculated to a holding tank (14) and then to the first stage contact zone (15). The scrubbing liquid is milk of lime, prepared by dissolving slaked lime in water. The slaked lime is fed from a bin (7) by a screw conveyor (8) through a mixer (9) into a dissolver (10). From the dissolver, the milk of lime is pumped to the second stage impingement zone (11) where the liquid height is controlled by a level tank (12). The liquid overflow is recirculated to the mixer.

The lower scrubber stage is provided with partially spent slurry from the two drop collectors. The overflow returns to the dissolver, which is also the level tank for the first stage. A regulator keeps the level constant in the dissolver by supplying fresh water.

A fraction of the return flow from the first drop collector (16) is continuously separated using a concentration regulator (17) into a thickener (18) which automatically feeds viscous waste sludge into a large basin (19). The sludge will be pumped into a settling pond or sanitary landfill facility.

The system is operated by the same personnel who operate the boilers, usually requiring only periodic checks and adjustment of slurry pH. No additional manpower and no unusual skills are required for the system.

EPA has funded a comprehensive test and evaluation program to be accomplished after the Air Force's acceptance test. Present schedule is for construction completion in November 1974. CE

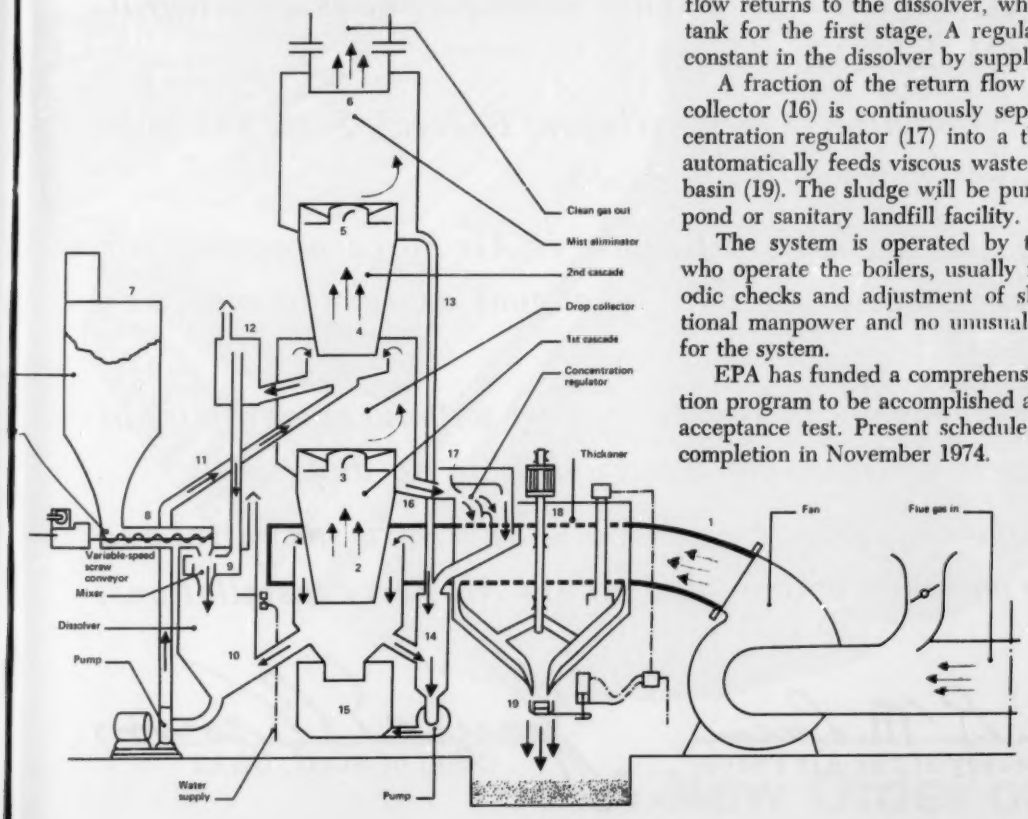

Figure 1: R/C Bahco SO_2 Scrubber.

UNITED STATES AIR FORCE

PLEDGE

to

ENVIRONMENTAL PROTECTION

THE UNITED STATES AIR FORCE is dedicated to National Defense. Inherent in this dedication is the commitment to protect our environment, to conserve energy and to preserve our natural resources. To this end, each of us pledge to . . .

Wholeheartedly support and demonstrate leadership for National Objectives to protect, preserve and enhance the environment.

Evaluate honestly and conscientiously each proposed Air Force action for environmental consequence as an integral part of the decision process.

Comply fully with the most stringent Federal, State and local environmental quality standards.

Actively support and participate in Air Force programs for environmental protection — a goal as fundamental as life itself.

Reverse trends in growing energy use without compromise of readiness, or lessening of our ability to fly and fight.

Encourage cooperation in community efforts to control and abate pollution both on and off our Air Force installations.

John L. M. Lucas
Secretary of the Air Force

George S. Brown
Chief of Staff, USAF

16 January 1974

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